

The Central Dogma of Molecular Biology

Background: One of the main foundations that modern biology relies on is called the Central Dogma of Molecular Biology. There are three parts to the Central Dogma:

1. DNA is used as a template to make more DNA in the process called replication.
2. DNA is used as a template to produce three kinds of RNA in a process called transcription.
3. RNA is used as a template to select the amino acid sequence of a protein in a process called translation.

This very important set of relationships can be symbolically represented by the formula:



To understand the Central Dogma and be able to use this knowledge in biology requires that you first learn to manipulate the DNA and RNA bases through the processes of replication, transcription and translation “on paper”. After you have a thorough understanding you can proceed to more challenging applications of your knowledge.

Purpose: To learn the three individual process that make up the Central Dogma of Molecular Biology: replication, transcription and translation. To allow for practice in manipulating DNA and RNA bases.

Part I:

Replication is the process used when cells divide to make a second copy of the DNA so that each daughter cell will have its own DNA molecule. Errors made during replication, even of one base, can cause serious harm to the organism and possibly death! We know that each base can only match with a complimentary base thanks to the work of Chargaff, Watson, Crick and Wilkins. They taught us that adenine (A) only pairs with thymine (T) and that cytosine (C) only pairs with guanine (G). In the process of replication the double strands of DNA separate and new bases are added to each side using the matching scheme just described. Here is an example showing only one side of the DNA molecule:

A T G A T G G A C T G T T T A A - original strand (we will call it the antisense strand)

To replicate this piece of DNA you will place the correct new base under each letter like this:

antisense strand	A T G A T G G A C T G T T T A A
sense strand	T A C T A C C T G A C A A A T T

Part II:

Use the DNA bases from the replication of the sense strand above and transcribe the RNA. Remember that RNA does not contain T and uses U instead. A table of hints may help:

if the sense strand of DNA is		then the RNA base in the mRNA would be
A		U
T		A
G		C
C		G

Part III: Practice Problems in Central Dogma Techniques

1. antisense strand A T G A C G G G G T A C C T A T G G T T A A A A T A G
sense strand
mRNA transcript
translation product
2. antisense strand A T G T T T C G C A T A T A A
sense strand
mRNA transcript
translation product
3. antisense strand A T G G C A G A G G T C A A A T A G
sense strand
mRNA transcript
translation product
4. antisense strand A T G A C C G A T T G A
sense strand
mRNA transcript
translation product
5. antisense strand A T G A A A T G C G A C G A T G C T A C A T A A
sense strand
mRNA transcript
translation product

The DNA Code

	Second Letter				
First Letter	U	C	A	G	Third Letter
	phenylalanine	serine	tyrosine	cysteine	U
U	phenylalanine	serine	tyrosine	cysteine	C
	leucine	serine	STOP	STOP	A
	leucine	serine	STOP	tryptophan	G
	leucine	proline	histidine	arginine	U
C	leucine	proline	histidine	arginine	C
	leucine	proline	glutamine	arginine	A
	leucine	proline	glutamine	arginine	G
	isoleucine	threonine	asparagine	serine	U
A	isoleucine	threonine	asparagine	serine	C
	isoleucine	threonine	lysine	arginine	A
	methionine/ Start	threonine	lysine	arginine	G
	valine	alanine	aspartate	glycine	U
G	valine	alanine	aspartate	glycine	C
	valine	alanine	glutamate	glycine	A
	valine	alanine	glutamate	glycine	G