

Cystic Fibrosis Worksheet

Adapted from *Cystic Fibrosis: An Approach to Understanding the Human Genome Project in Correlation With Genetic Disorders*. By William Humphries, published by Science Kit and Boreal Labs, 2001.

Cystic Fibrosis (CF) is a potentially devastating disorder that affects primarily the lungs. It is caused by a defect in Chromosome 7 at position 7q 31.2, a gene that codes for the Cystic Fibrosis Transmembrane Regulator (CFTR) protein, which is found in the cell membranes of mucous membrane cells in the human respiratory system and the digestive system. The protein is an ion channel that normally controls the movement of chloride (Cl⁻) ions. If the protein channels are defective, then salt balance is disrupted. Salt tends to be retained in the cells, which tends to cause water in the mucous to move into these cells by osmosis. This leaves the mucous sticky and thick, which leaves people with Cystic Fibrosis more prone to lung infections. CF sufferers may also need to take enzymes with their food to assist digestion.

How severe any one case of CF is depends on the type of mutation. There are over 900 known mutations to the CFTR gene, pointing to over 900 points of origin for this disease. The most common mutation is the Δ 508 ("delta 508") mutation.

In this exercise, you will transcribe and translate one small segment of a normal CFTR gene and a segment with the Δ 508 mutation. First, create the "sense" strand, using the "non-sense" strand to guide you, using the base-pairing rule. Next, transcribe the RNA sequence using the base-pairing rule from DNA to RNA. Finally, use the codon table (below) to transcribe the RNA sequence into an amino acid chain. Compare the two chains. Where do you see a difference?

Normal strand:

DNA (nss): A A A G A A A A T A T C A T C T T T G G T G T T T C C T A T G A T G A A

DNA (ss): T T T

mRNA: A A A

AA: Lys

Δ 508 strand:

DNA (nss): A A A G A A A A T A T C A T C G G T G T T T C C T A T G A T G A A

DNA (ss): T T T

mRNA: A A A

AA: Lys

Hint: Divide the DNA non-sense strand into codons (triplets) to make transcription and translation easier.

Second Position

		U	C	A	G	
First Position	U	UUU } Phe	UCU } Ser	UAU } Tyr	UGU } Cys	U
		UUC } Phe	UCC } Ser	UAC } Tyr	UGC } Cys	C
		UUA } Leu	UCA } Ser	UAA } Stop	UGA } Stop	A
		UUG } Leu	UCG } Ser	UAG } Stop	UGG } Trp	G
	C	CUU } Leu	CCU } Pro	CAU } His	CGU } Arg	U
		CUC } Leu	CCC } Pro	CAC } His	CGC } Arg	C
		CUA } Leu	CCA } Pro	CAA } Gln	CGA } Arg	A
		CUG } Leu	CCG } Pro	CAG } Gln	CGG } Arg	G
	A	AUU } Ile	ACU } Thr	AAU } Asn	AGU } Ser	U
		AUC } Ile	ACC } Thr	AAC } Asn	AGC } Ser	C
		AUA } Met	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	U
		GUC } Val	GCC } Ala	GAC } Asp	GGC } Gly	C
		GUA } Val	GCA } Ala	GAA } Glu	GGA } Gly	A
		GUG } Val	GCG } Ala	GAG } Glu	GGG } Gly	G

Third Position