



III. The DNA sequence shown below was taken from GenBank and is listed as the beginning of the gene for human phenylalanine hydrolase. The enzyme has also been purified and shown to begin with glycine.

**5' ATGGGAATCATGGCAGCATCCAGGCCA--- 3'**  
**3' TACCCTTAGTACCGTCGTAGGTCCGGT---5'**

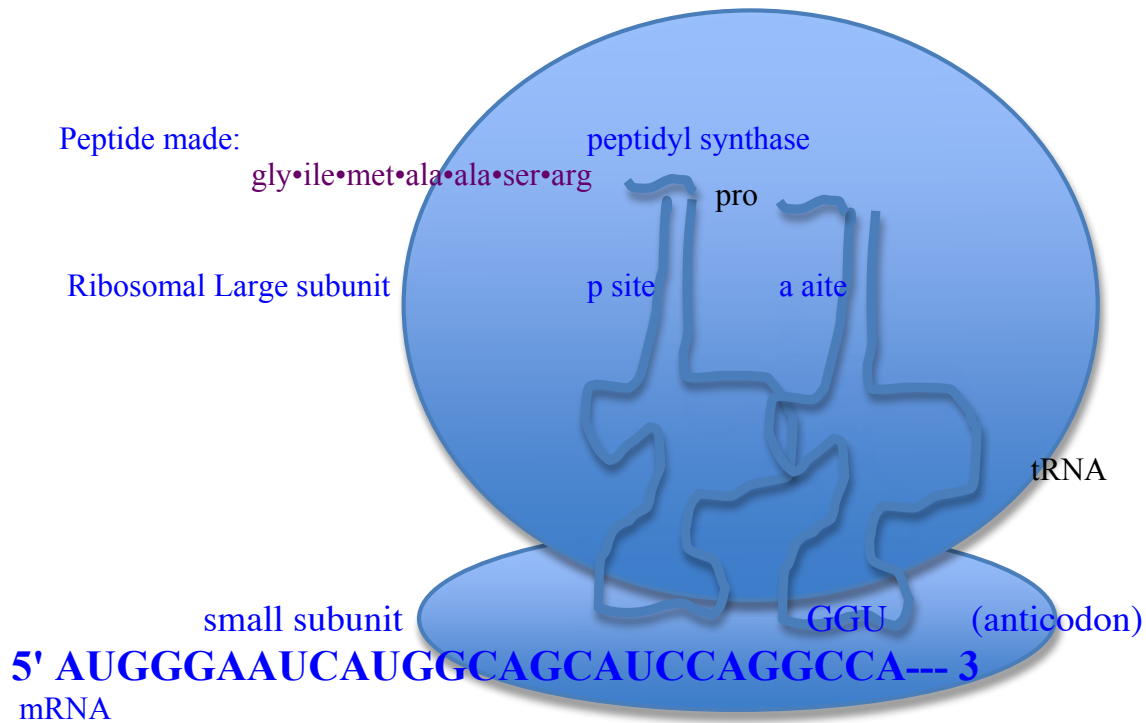
a) Write the complementary DNA strand above or below the given strand

b) Is the given strand or the one you wrote the template strand for transcription? One I wrote  
 What clue(s) did you use to decide?  
 It would give a 5' AUG start in the mRNA and in this case a protein starting with gly

c) Write the mRNA that would be produced via transcription.

**5' AUGGGAAUCAUGGCAGCAUCCAGGCCA--- 3'**

d) Make a labeled drawing showing translation (and the peptide made) just as the last codon of your mRNA is about to be translated.



IV. A few of the many specific changes that create mutant alleles for the beta-globin gene are listed below, along with the change as it is reflected either in the DNA, mRNA or protein encoded. Each of the mutant alleles is the result of the point mutation described.

Allele	Position	Change in DNA, mRNA or protein
0316	codon 43	GAG to UAG
0321	codon 60	val to glu
0376	-31(in promoter)	A in TATAA (TATA box) to TGTA
0279	codon 145 (of 146)	10 extra amino acids
0081n	codon 81	GGA to GGC

A) Tell whether each mutant allele results from transition (I), tranversion (V) or frameshift (FS):

0316 V 0321 V 0376 I 0279 FS 0081n V

B) Tell whether each mutation is a **missense**, **nonsense**, **samesense**, **frameshift** or **regulatory defect**:

0316 non 0321 mis 0376 reg 0279 FS 0081n same

C) Homozygosity for one of the alleles causes

$\beta^0$ -thalassemia; which allele is the most likely? 0316

D) Only one of the alleles causes **no** detectable anemia; which one? 0081n

E) Two of the alleles can cause  $\beta^+$  (mild) -thalassemia; they are? 0321, 0279

F) Which, if any, of the mutations could be caused by the following mutagens?

1) ICR, 171, an acridine dye 0279

2) 5-Bromouracil 0376

3) EMS 0316, 0321, 0376, & 0081

V Rank the following “agents” for potential mutagenicity, where 1 would cause the most **germline** mutations in humans and 3 the least:

a) 1 NG (nitrosoguanidine) 3 UV light 2 nitrous acid (HNO<sub>2</sub>)

b) 2 saccharin 1 X-rays 3 caffeine

c) 3 dioxin 2 5-bromouracil 1 NG

**VII.** Fill in the chart below that describes the activity of the lac operon for each of the listed strains. Use + to indicate the enzyme is present at high levels and - if absent or present at very low levels. The minus superscript after a component indicates it is inactive.

Genotype	growing on lactose		growing on glucose	
	$\beta$ -gal'ase	permease	$\beta$ -gal'ase	permease
$p_i p O Z Y A$	+	+	-	-
$p^- i p O Z^- Y A$	-	+	-	+
$p_i p O^- Z^- Y A$	-	+	-	+
$p_i p O Z^- Y A$	-	+	-	+
$p_i p^- O Z Y A$	-	-	-	-
$p^- i p O Z Y^- A$	+	+	-	+
$p_i p O^- Z^- Y A$	-	+	-	-
$p_i p^- O Z Y A$	-	-	-	-
$p_i p O Z^- Y A$	+	+	+	-

**VIII.** Match the following recombinant DNA terms or tools with the correct definition.

Term/tool	Definition/role
<u>G</u> Ori	A) cut DNA at a specific base sequence
<u>      </u> DNA Ligase	B) amplify DNA between flanking primers
<u>F</u> Reverse transcriptase	C) allows blue-white screening
<u>C</u> LacZ gene in a pUC plasmid	D) sequence in vector with several restriction sites
<u>E</u> AMP <sup>R</sup>	E) selectable marker for presence of plasmid
<u>D</u> Multiple cloning site	F) make DNA complement to mRNA
<u>A</u> Restriction endonuclease	G) required for plasmid replication
<u>B</u> TAQ polymerase	H) connect DNA fragments

(The last line was inadvertently left off the exams)