

# Annotation of *Helicobacter pylori* at Locus Tags HP1198, HP1241, HP1319, and HP1450

Deanna Meyer, Elizabeth Newell, Natalie Perl, Mary Weber, and Laura O'Donnell

Attica High School- Attica, NY and The Western New York Genetics in Research and Health Care Partnership



## Abstract

A group of genes from the microorganism *Helicobacter pylori* were annotated using the collaborative genome annotation website GENI-ACT. The GenBank proposed gene product name for each gene was assessed in terms of the general genomic information, amino acid sequence-based similarity data, structure-based evidence from the amino acid sequence, and cellular localization data. The GenBank proposed gene product name did not differ significantly from the proposed gene annotation for each of the genes in the group and as such, the genes appear to be correctly annotated by the computer database.

## Introduction

*Helicobacter pylori* was first discovered in the biopsies of patients suffering from chronic gastritis and stomach ulcers. The bacteria is fairly common with about two-thirds of the population having the bacteria in their body already. Although the bacteria is in the body for years, a person may never experience symptoms of stomach ulcers or any other issues *H. pylori* can cause. Scientists suspect that the bacteria is contagious through unclean food or water and it seems to be more common in people that live in unsanitary conditions.

Once *H. pylori* enters the stomach, it goes through four steps to establish a successful settlement. First, it has to survive the acidity of the stomach by releasing an enzyme that changes urea into ammonia which neutralizes the acid and creates a more hospitable environment. After *H. pylori* remains in the stomach, it moves toward epithelium cells using its flagella. As soon as it reaches the cells, the bacteria attaches itself to the host where it releases toxins which harm the stomach tissue and cause damage to the stomach and intestinal walls.

The World Health Organization classified *H. pylori* as a group one carcinogen, meaning that it has a high chance of giving a person cancer. Doctors treat *H. pylori* antibiotics but resistance is on the rise.



Colored scanning electron micrograph of *H. pylori* on surface of gastric cells  
web.stanford.edu

## Methods

Modules of the GENI-ACT (<http://www.geni-act.org/>) were used to complete *Helicobacter pylori* genome annotation. The modules are described below:

Modules	Activities	Questions Investigated
Module 1- Basic Information Module	DNA Coordinates and Sequence, Protein Sequence	What is the sequence of my gene and protein? Where is it located in the genome?
Module 2- Sequence-Based Similarity Data	Blast, CDD, T-Coffee, WebLogo	Is my sequence similar to other sequences in Genbank?
Module 3- Structure-Based Evidence	TIGRfam, Pfam, PDB	Are there functional domains in my protein?
Module 4- Cellular Localization Data	Gram Stain, TMHMM, SignalP, PSORT, Phobius	Is my protein in the cytoplasm, secreted or embedded in the membrane?

## Results

Gene Locus: HP1198		
Basic Information	DNA Coordinates	complement(1268377..1277049)
	DNA Length	8673 nt
	Amino Acid Sequence Length	2890 aa
Sequence-based Similarity	COGS	no significant hits
	T-Coffee	no orthologs present
	Web-Logo	no orthologs present
Structure-based Evidence	TIGRFAMs	no significant hits
	PFAMs	pfam00562 RNA polymerase Rpb2
	HMM Logo Key Residues	D95, G243, D244, G254, P284, R286
	PDB	RNA polymerase
Cellular Localization	Transmembrane Helices	none
	Signal Peptide	none
	PSORTb Final Prediction	cytoplasmic

*Helicobacter pylori* HP1198:

PFAM, and PDB data supports HP1198 to be an RNA polymerase protein which synthesizes RNA from DNA during transcription in the process of protein synthesis. No orthologs were shown in the BLAST database. Cellular localization predicts that this protein functions in the cytoplasm.

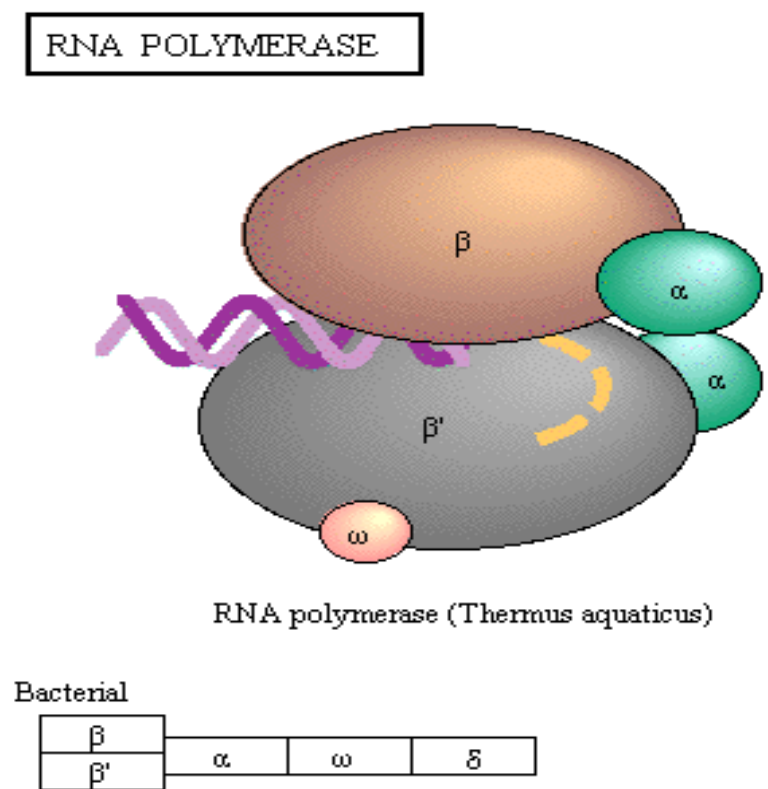


Figure 1 shows RNA polymerase and its subunits in the bacteria *Thermus aquaticus*- [www.genome.jp/kegg/](http://www.genome.jp/kegg/)

Gene Locus: HP1241		
Basic Information	DNA Coordinates	complement(1314188..1316731)
	DNA Length	2544 nt
	Amino Acid Sequence Length	847 aa
Sequence-based Similarity	COGS	No significant hit
	T-Coffee	No orthologs present
	Web-Logo	Not well conserved
Structure-based Evidence	TIGRFAMs	No significant TIGERFAM hits
	PFAMs	No significant PFAM hits
	HMM Logo Key Residues	No HMM Logo Key Residues
	PDB	Alanyl-tRNA synthetase
Cellular Localization	Transmembrane Helices	none
	Signal Peptide	none
	PSORTb Final Prediction	cytoplasmic

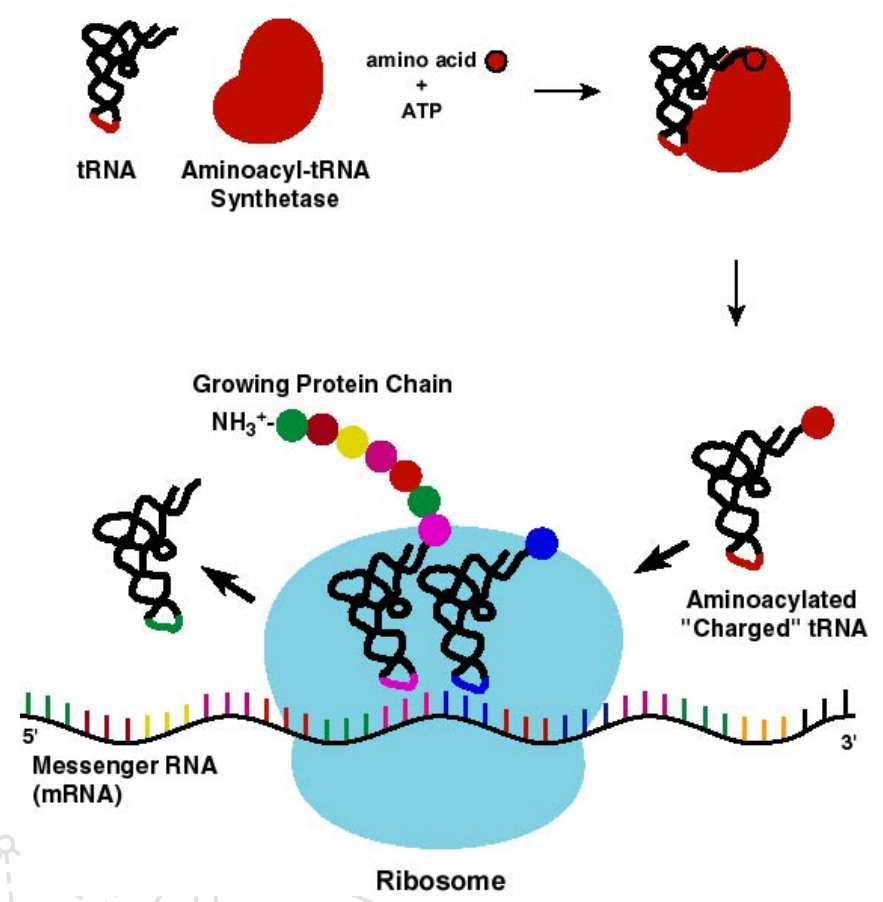
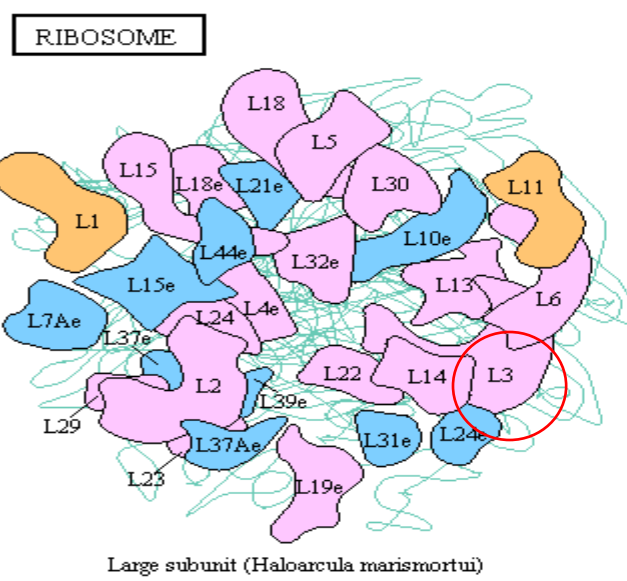


Figure 2 shows an aminoacyl-tRNA synthetase during the process of translation in protein synthesis-  
<http://www.dna.neu.edu>

*Helicobacter pylori* HP1241:

Although there is little evidence provided, PDB data supports HP1241 to be an alanyl-tRNA synthetase. This protein catalyzes the attachment of an amino acid to its transfer RNA molecule for the process of protein synthesis. No orthologs were shown in the BLAST database. Cellular localization predicts that this protein functions in the cytoplasm.

Gene Locus: HP1319		
Basic Information	DNA Coordinates	complement(1380290..1380865)
	DNA Length	576 nt
	Amino Acid Sequence Length	191 aa
Sequence-based Similarity	COGS	COG0087: RplC:Ribosomal protein L3 [Translation, ribosomal structure and biogenesis];
	T-Coffee	Well conserved until the very end
	Web-Logo	Not well conserved
Structure-based Evidence	TIGRFAMs	TIGR03625:L3_bact; ribosomal protein L3
	PFAMs	pfam00297; Ribosomal_L3
	HMM Logo Key Residues	W236
Cellular Localization	PDB	complex containing domain 3 bound to the 70S ribosome.
	Transmembrane Helices	none
	Signal Peptide	none
Cellular Localization	PSORTb Final Prediction	cytoplasmic



*Helicobacter pylori* HP1319:

COG, TIGRFAM, PFAM, and PDB data suggests that HP1319 is a ribosomal protein. Ribosomal proteins function in the translation of RNA in protein synthesis. Cellular localization data predicts that HP1319 functions in the cytoplasm.

Figure 3 shows the large and small subunit of a ribosome. Circled in red is the L3 domain making up part of the large subunit-  
[www.genome.jp/kegg/](http://www.genome.jp/kegg/)

Gene Locus: HP1450		
Basic Information	DNA Coordinates	complement(1517906..1519549)
	DNA Length	1644 nt
	Amino Acid Sequence Length	547 aa
Sequence-based Similarity	COGS	COG0706: YidC-Membrane protein insertase Oxa1/YidC/SpoIIJ
	T-Coffee	well conserved until very end
	Web-Logo	well conserved from position 1-30 then not well conserved until the end
Structure-based Evidence	TIGRFAMs	yidC_oxa1_cterm:membrane protein insertase, [Protein fate, Protein and peptide secretion and trafficking]
	PFAM	pfam02096:60KD_IMP
	HMM Logo Key Residues	Y149
Cellular Localization	PDB	EM fitted model of bacterial holo-translocon
	Transmembrane Helices	6
	Signal Peptide	none
Cellular Localization	PSORTb Final Prediction	cytoplasmic membrane

*Helicobacter pylori* HP1450:

COG, TIGRFAM, PFAM, and PDB data suggests that HP1450 is a membrane protein insertase that is required for the insertion and or proper folding of membrane proteins. Cellular localization data predicts that HP1450 has 6 transmembrane helices, residing in the cytoplasmic side of the cell membrane.

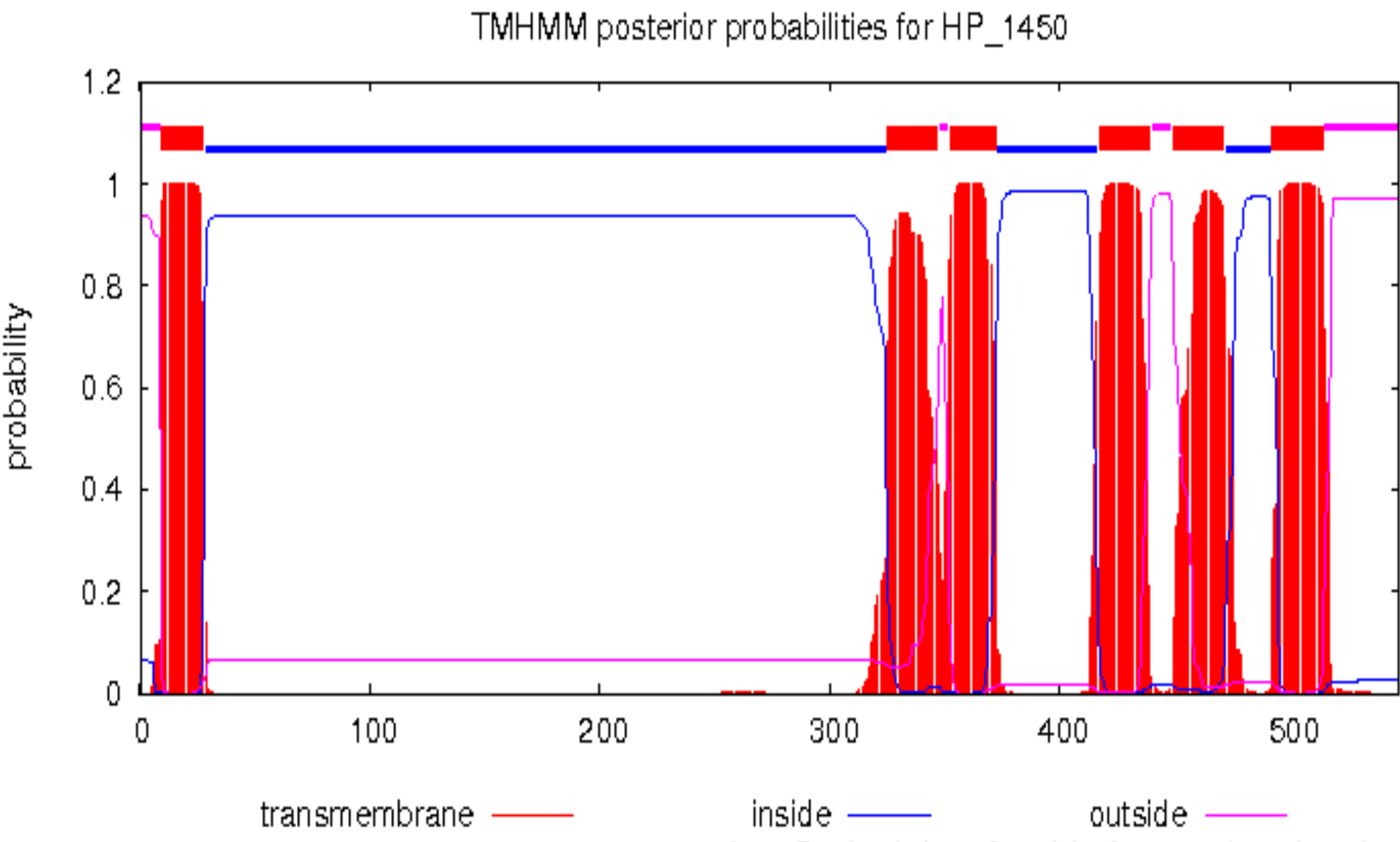


Figure 4 – TMHMM data for *Helicobacter pylori* HP1450. The cellular localization data shows the presence of 6 transmembrane helices

## Conclusion

The GENI-ACT proposed gene product did not differ significantly from the proposed gene annotation for each of the genes in the group and as such, the genes appear to be correctly annotated by the computer database. All proteins annotated seem to be involved with the processes of transcription and translation in *H. pylori*.

Gene Locus	Geni-Act Gene Products	Proposed Annotation
HP1198	RNA polymerase	RNA polymerase
HP1241	Alanyl-tRNA synthetase	Alanyl-tRNA synthetase
HP1319	Ribosomal protein L3	Ribosomal protein L3
HP1450	Membrane protein insertase	Membrane protein insertase

## References

*Helicobacter pylori* infection: An overview of bacterial virulence factors and pathogenesis. (2016, April 01). Retrieved from <https://www.sciencedirect.com/science/article/pii/S2319417016000160>

*H. pylori* Bacteria Infection: Symptoms, Diagnosis, Treatment, Prevention. (n.d.). Retrieved from <https://www.webmd.com/digestive-disorders/h-pylori-helicobacter-pylori#1>

## Acknowledgments

Supported by an NIH Science Education Partnership (SEPA) Award - R25ODO10536

[www.buffalo.edu](http://www.buffalo.edu)