**Question 3:**

catalase responded least to change in temp.

Catalase breaks down H2O2 to oxygen and water.

It is located in the peroxisome.

**PRIMERS:**

1. **RpoS:** forward: CAATGCCGATCCTGAGTTT; reverse: TCTTCCAAGGTCGATGGTTC
2. **TcpA:** Forward: AGTTGCACTGACACAGACATACC; Reverse: ACCTAAACTAACCAAGCCTGAAGT

**Second Try:**

**Rpos: Forward:** TGCGTCTTAACGAGCGTATT; Reverse: TCGACGTAAACCCTCCACTT

**Product size 299**

**Tm 59**

**GC 45-50**

**TcpA: Forward:** AGTTGCACTGACACAGACATACC; Reverse: TGGGAACATATCACCGACAC

**Product size 265**

**Tm 59**

**GC 48-50**

HN-S – hemagglutinin (HA)/protease

Histone-like nucleoid structuring protein

Thought to enhance enterotoxicity in GI and silence virulence gene expression

Enhanced resistance to low pH and H2O2 and reduced motility

**RpoS** – expression of genes in response to starvation, osmotic shock, oxidative stress and temperature. At translation – several trans acting factors can bind to rpoS mRNA in response to high osmolarity, low temp and acidic pH to enhance translation

toxin-coregulated pilus (TCP) tcpA (major subunit)

RpoS

>gi|227080237:522179-523186 Vibrio cholerae M66-2 chromosome I, complete genome

ATGAGTGTCAGCAATACCGTAACCAAAGTAGAAGAGTTCGATTTTGAAGATGAAGCACTGGAAGTGCTAG

AAACTGATGCCGAGCTCACCAGTGATGAAGAATTAGTTGCTGTTGAAGGGGCAAGTGAAGACGTTCGTGA

AGAGTTTGATGCTTCTGCGAAAAGTCTTGATGCGACCCAGATGTATCTCAGCGAAATTGGTTTTTCACCG

CTCCTTACTGCCGAAGAAGAAGTGCTTTATGCTCGTCGTGCCTTACGTGGTGATGAAGCCGCACGTAAAC

GCATGATTGAAAGTAACTTGCGTCTGGTGGTAAAAATTTCACGCCGTTACAGCAACCGAGGATTAGCACT

GCTCGATCTGATTGAAGAAGGTAATCTTGGTCTGATCCGTGCGGTTGAGAAATTCGATCCAGAACGCGGT

TTCCGCTTCTCTACCTACGCAACATGGTGGATCCGTCAAACCATTGAACGTGCGCTGATGAACCAAACAC

GCACCATTCGTCTACCGATTCATGTCGTCAAAGAGCTGAACATTTATTTGCGTACTGCTCGCGAATTATC

ACAGCGCCTTGACCACGAACCTACACCAGAAGAAATTGCTCTTGAGTTAGACCGACCTGTCGATGATGTC

ACTAAGATGCTGCGTCTTAACGAACGGATCAGCTCAGTGGATACGCCAATTGGTGGGGATGGAGATAAGG

CACTGCTGGATATTTTGCCAGACTCTCACAATGCCGATCCTGAGTTTTCAACTCAAGATGATGACATTCG

TGAATCGCTGCTCAACTGGTTGGATGAACTTAATCCAAAGCAAAAAGAAGTGCTTGCGCGTCGCTTTGGG

CTTCTTGGCTATGAACCATCGACCTTGGAAGAAGTGGGTCGTGAGATCAATCTCACTCGTGAGCGTGTTC

GCCAAATCCAAGTGGAAGGTCTACGTCGTCTGCGTGAGATTTTGGTGAAACAAGGTTTGAATATGGAAGC

GCTGTTTAACGTCGAATACGACAACTAA

>gi|28200486|gb|AY187681.1| Vibrio vulnificus lipoprotein D (nplD) gene, partial cds; RNA polymerase subunit sigma factor S (rpoS) gene, complete cds; and DNA mismatch repair protein (mutS) gene, partial cds

GATCGTGGTAGCTATCGTGGCAGCTACTACGAAGTTGAAAAGGGCGATACGCTGTATTTTATATCCTACG

TCACAGATAAAGATGTAAATGAGTTAATCCGTTTCAATAATTTGACAGAGCCTTACACGATTTATCCGGG

CCAGAAACTCAAGTTATGGGCACCTGCTTATGTCGCACCCAAATATGGCCAAACGGTAGAAGCCCCTGTT

ACCACTGTGGTTGCTGCGTCAACTGTCGCGGTGGTGACTCCCAAACCAACACCGACAACGCCAAAAAAAT

CGAATAATAACTCTACTCAGAAACCCGCAAAACCTGCGCCTCAAGTGGTTAAAAAAGATCCAGTTAAGGG

TATTGATCAATCCAAACCAAAGGAGTATGTTGGTTCAAAAGGTAAAGAAAATGTTAAACCTATCACTTCG

CCACCACCGGCAAATAACCAAAAAATAGCCAAGTGGCAGTGGCCAACAAAAGGGAGAGTAATCAAAAACT

TCTCTGCAGGAGAACAAGGAAATAAAGGCATTGATATCGCAGGACAGCGAGGTCAGCCTATCGTTTCAAC

GGCAGGAGGTACCGTGGTTTATTCGGGTAACGCGCTAAGAGGTTATGGCAATTTAATCATTGGTAAACAT

AACGATAATTACCTCAGTGCGTATGCGCATAACGATCGGTTGTTGGTATCGGAAGGGCAAAGTGTTAAAG

CTGGGCAACAAATAGCCACAATGGGCAGTTCTGGAGCCAAAACAGTGATGTTGCACTTCGAAATTCGTTA

CCAAGGTAAATCAGTGAATCCAAAGCGCTATTTACCGTAAATCAACTTTGAAACAACTTGCGACACAACT

AGCGACATTTAAAGTTGTAATGTCTTGCTAACTCGCCATGGGGAGGCGTTATGAGTATCAGCAACACAGT

CACCAAAGTTAAAGATTTCGATGTTAATCAGATGGATGATGATTTTAACGACGATATCGAGATTAATGAA

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CGACACAGCTTTATCTAGGAGAAATTGGTTTTTCTCCACTATTAACCGCAGAAGAAGAAGTGCTTTATGC

TCGACGTGCATTACGAGGCGATGAAGCCGCACGTAAACGTATGATTGAAAGTAACTTACGTCTAGTGGTT

AAGATTTCCCGCCGTTACAGTAATCGCGGTCTTGCACTGCTAGATTTGATTGAAGAGGGTAACCTTGGTT

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TTCTGTCGATACGCCGATTGGTGGAGATGGAGAGAAGGCGTTATTAGATATTATTCCGGATGCAAACAAC

TCTGACCCAGAGGTTTCAACGCAAGATGAAGACATGCGTGTTTCCTTGATTCATTGGTTGGAAGAGCTCA

ATCCGAAACAAAAAGAAGTGTTGGCACGTCGCTTTGGTTTGTTGGGTTATGAGCCTTCAACGCTGGAAGA

GGTTGGGCAAGAGATTGGTTTAACTCGCGAGCGAGTGCGCCAGATTCAGGTTGAAGGGTTACGTCGCCTC

CGTGAAGTTCTGATCAAACAAGGTCTGAATATGGAAAATTTGTTTGATATCGTATGGATTGAATTTGCAT

TCTCCAATAGAAAAAAGGCTATGGAATCATAGCCTTTTGTCATTTTAGTGAGGTTCGTTTAAAAACGTTA

GAGCATTTTCTTTAAACGATATAGGGCTTCTAACGCTTGGCGTGGGGTCAGATCATCGGGATCGATGCTG

GCCAACGCTTGTTCTACTTCACTTGGCTCTGGAATGAGGCTCAATTGGTTAGCGATATCCACCGTTCTTG

CTTTCGGCTGCGAACCCTCTGCGCTGAGTAGCTCAAGTTGAGACAATTTTTGACGGGCGTTTTTAATCAC

CGTTTTTTCCAACGCCGCTAACCCCGCCACAGCCAAACCGTAGGATTTGCTCGCCGCCCCTTCTTGTCGG

GCGTGCATAAAGGCGATGCTGTCGCCATGCTCAACCGCATCAAGATGCACGTTGGCCAAGTGAGGGAGTT

GATTTGGCAGTTCTGTCAGTTCAAAGTAATGCGTCGCAAATAGCGTCATTGCCCCAATCTGAGTCGCAAG

CCAAGTGTCGCTTGCCCACGCTAGGGAAAGACCATCATAGGTACTGGTACCACGGCCAATTTCATCCATC

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AAGCACCTGACGCGAGATCATCCGATGCACCAATTCGAGTAAAGATGCGATCAATTGTGCCAATGGTGGC

CGATTCTGCAGGAACGTAAGAACCAATGTGCGCCATTAAAGCAATCAATGCGGTTTGGCGCATGTAGGTG

GACTTACCCCCCATGTTTGGACCGGTGATGATC

>gi|157674652|gb|EU143550.1| Vibrio parahaemolyticus strain VIB304 RpoS (rpoS) gene, complete cds

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ATAACGAACTCGAAAAATCATCATCTACTACCGAAGGCAAAACAGCTGTCCGTGAAGAGTTTGACGCGAG

CAGTAAAAGCCTAGACGCAACTCAATTGTATCTAGGTGAAATTGGCTTCTCACCTCTACTTACTGCTGAA

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ACTTGCGTTTAGTAGTAAAAATTTCTCGTCGGTACAGCAACCGTGGCCTAGCGCTACTCGATCTTATTGA

AGAAGGTAACCTCGGTTTGATCCGAGCGGTTGAAAAATTCGATCCAGAAAGAGGCTTCCGTTTCTCAACT

TACGCAACATGGTGGATCCGTCAAACGATCGAACGTGCGTTGATGAACCAAACTCGCACCATTCGCTTGC

CTATTCATGTCGTGAAAGAGCTGAACATTTATCTGCGTACTGCGCGTGAACTTTCTCAAAAGCTCGATCA

TGAACCAACTGCAGAAGAAATTGCTGCTCAATTAGATATACCAGTAGAAGATGTCAGCAAAATGCTGCGT

CTTAACGAGCGTATTAGCTCCGTTGATACCCCAATTGGTGGTGACGGTGAAAAAGCGCTTCTGGATATTA

TTCCTGACGCAAATAACTCTGATCCAGAAGTGTCGACTCAAGATGATGACATCAAATCGTCTTTGATCCA

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CCGTCTACGCTTGAAGAAGTGGGACGAGAGATTGGTCTTACCCGTGAGCGTGTACGTCAAATTCAAGTGG

AGGGTTTACGTCGACTTCGTGAAATCCTAATTAAACAAGGCCTAAATATGGAAAACTTGTTTAACGTCGA

AGACGATTAATACTAAGCTTTCTCGAAACACAAAGGGCTATGGATAACCATAGCCCTTTTCTGTTTTAGG

GGAGATTAGATATTCTCGTTAAAGCATTTTCTTCAAACGATACAGCTCTTCAAGGGCTTGACGAGGTGTT

AAGTCGTCTGGATCGATGTTTGATAACGCTTGTTCAATTTCGCTAGG

>gi|147673035:55517-56524 Vibrio cholerae O395 chromosome 2, complete sequence

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AAACTGATGCCGAGCTCACCAGTGATGAAGAATTAGTTGCTGTTGAAGGGGCAAGTGAAGACGTTCGTGA

AGAGTTTGATGCTTCTGCGAAAAGTCTTGATGCGACCCAGATGTATCTCAGCGAAATTGGTTTTTCACCG

CTCCTTACTGCCGAAGAAGAAGTGCTTTATGCTCGTCGTGCCTTACGTGGTGATGAAGCCGCACGTAAAC

GCATGATTGAAAGTAACTTGCGTCTGGTGGTAAAAATTTCACGCCGTTACAGCAACCGAGGATTAGCACT

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TTCCGCTTCTCTACCTACGCAACATGGTGGATCCGTCAAACCATTGAACGTGCGCTGATGAACCAAACAC

GCACCATTCGTCTACCGATTCATGTCGTCAAAGAGCTGAACATTTATTTGCGTACTGCTCGCGAATTATC

ACAGCGCCTTGACCACGAACCTACACCAGAAGAAATTGCTCTTGAGTTAGACCGACCTGTCGATGATGTC

ACTAAGATGCTGCGTCTTAACGAACGGATCAGCTCAGTGGATACGCCAATTGGTGGGGATGGAGATAAGG

CACTGCTGGATATTTTGCCAGACTCTCACAATGCCGATCCTGAGTTTTCAACTCAAGATGATGACATTCG

TGAATCGCTGCTCAACTGGTTGGATGAACTTAATCCAAAGCAAAAAGAAGTGCTTGCGCGTCGCTTTGGG

CTTCTTGGCTATGAACCATCGACCTTGGAAGAAGTGGGTCGTGAGATCAATCTCACTCGTGAGCGTGTTC

GCCAAATCCAAGTGGAAGGTCTACGTCGTCTGCGTGAGATTTTGGTGAAACAAGGTTTGAATATGGAAGC

GCTGTTTAGCGTCGAATACGACAACTAA

**TcpA ---------------------**

**Vibrio cholerae M66-2 chromosome I, complete genome**

>gi|187235749|gb|EU622527.1| Vibrio cholerae O1 strain ZJ22 toxin-coregulated pilin (tcpA) gene, complete cds

ATGTGCGTATTGCTTACGTTATCTAAAAAAGACCAAGCAATGCATTTCCTTAAAACACAGTAAAATGGTG

GAGTTACATAAATATGCAATTATTAAAACAGCTTTTTAAGAAGAAGTTTGTAAAAGAAGAACACGATAAG

AAAACCGGTCAAGAGGGTATGACGCTACTCGAAGTGATCATCGTTCTAGGCATTATGGGTGTGGTTTCGG

CGGGGGTTGTTACTCTGGCGCAGCGTGCGATTGATTCGCAGAATATGACCAAGGCCGCGCAAAATCTAAA

TACAATTCAAGTTGCAATGACTCAAACCTATCGTAGTCTAGGTTCGTACCCTGCAACAGCTGATGCAAAT

GCAGCCGGACGTTTGACATCTGGATTGGTAAGTTTGGGTAAGATTTCTGCAGACGAAGCAAAAAACCCTT

TTACTGGGACTAATATGAACATCTTTGCTTTCAACCGAAATACAGCAGCTCAGAAAGCCTTTGCTATTGC

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AGTTTAATTTAATCTTAATGTTGCCCATTAAATAATGGGCAACTTATTGAATTCAATATGGTATCAATA

>gi|169805230|gb|EU362122.1| Vibrio cholerae strain NON-O1/NON-O139 toxin co-regulated pilus A variant (tnpA) gene, complete cds

ATGCAATTATTAAAACAGCTTTTTAAGAAGAAGTTTGTAAAAGAAGAACACGATAAGAAAACCGGTCAAG

AGGGTATGACACTACTCGAAGTGATCATCGTTCTAGGTATTATGGGTGTGGTTTCGGCGGGGGTTGTTAC

TCTGGCGCAGCGTGCGATTGATTCGCAGAATATGACCAAGGCCGCGCAAAATCTAAATACAATTCAAGTT

GCAATGACTCAAACCTATCGTAGTCTAGGTTCGTACCCTACAACAGCTGATGCAAATGCGGCCGGACGTT

TGACATCTGGATTGGTAAGTTTGGGTAAGATTTCTGCAGACGAAGCAAAAAACCCATTTACTGGGACTAA

TATGAACATCTTTGCTTTCAGCCGAAATACAGCACCTCAGAAAGCCTTTGCTATTGCAGTTGACGGTTTG

ACAAAAGCACAATGTAAATCGCTTGTTACAAGTGTCGGTGAAATGTTCCCTTACATTGTAGTTAAGGAAG

GTGCTGCTGTCGAAAATGCTGACCTAAAGGACTTTGAAACAGAAGCTCCTGTTGGTAATACAGATAAAGG

TGTTATTAAGTCTATAGCTACAGGTGTTAATTTAAACTTAACAGACGTAACGCACGTGGAAAATCTTTGT

TCAGGTACAGGTAATGCGTTCTCTGTTGCATTTGGTAACAGCTAA



>gi|227080237:847901-848575 Vibrio cholerae M66-2 chromosome I, complete genome

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GCTGGCTCAGCGTGCGATTGATTCGCAGAATATGACTAAGGCTGCGCAAAATCTAAACAGCGTGCAAATT

GCAATGACACAAACTTATCGTAGTCTTGGTAATTATCCAGCTACCGCAAACGCAAATGCTGCTACACAGC

TAGCTAATGGTTTGGTCAGCCTTGGTAAGGTTTCAGCTGATGAGGCAAAGAATCCTTTCACTGGTACAGC

TATGGGGATTTTCTCATTTCCACGAAACTCTGCAGCGAATAAAGCATTCGCAATTACAGTCGGTGGCTTG

ACCCAAGCACAATGTAAGACTTTGGTTACAAGCGTAGGGGATATGTTTCCATTTATCAACGTGAAAGAAG

GTGCTTTCGCTGCTGTCGCTGATCTTGGTGATTTCGAAACGAGTGTCGCAGATGCTGCTACTGGCGCTGG

CGTAATTAAGTCCATTGCACCAGGAAGTGCCAACTTAAACCTAACTAATATCACGCATGTTGAGAAGCTT

TGTACAGGAACTGCTCCATTCACAGTAGCTTTTGGTAACAGTTAA

>gi|172087787:c987683-987057 Vibrio fischeri ES114 chromosome II, complete sequence

ATGAATTTAAAAAAACAACGAGGTATGACCTTACTAGAAGTGATTATCGTTTTAGGCATTATGGGTGTCA

TTTCTGCCGGTGTTGTAATCCTAGCTCAAAGAGCAATCGATAATCAGAATGTATCTAAGTTATCGCAAGC

GTTAAATACTATTCAAACCGCAATGGTTCAAACTTATAGAAGTAAGCAAAGTTATCCTGATGTTCTTCAA

GATGCAGTTAAGGCTAAAAAGTTAACTGATGCATTAGTGTCTATGGGGAGAGTTACTGAATCAGATTTAA

TCAACCCATTTACGGGTGCTCCAATGTTGATCTTTACAGCTAAGGACAACAAGGCGGCTAACCGTGGTTT

TGCTATTAAAGTATCTGATTTGTCAAAAGATCAATGTACCTCGTTAATAAGTAACTCAGCAGATCTATTT

AGTTTTATTGAAGTACAAAATAGAGGTACAGCAATGGCGGCGGATTTTTATGTTGACCCAGATGCAACAA

AATCAGTTGGAGTTATTAAATCAACAAAAGGTGGTGCTAAAACTTTAGATCTTACAAATCTTGACCACAT

CTCGGCTCTGTGTGGTGGGCCAGGTGCGGGTGATTCGTACTTTGATGTTTTTGTTGGTAATCGTTAA

>gi|147673035:381188-381862 Vibrio cholerae O395 chromosome 2, complete sequence

ATGCAATTATTAAAACAGCTTTTTAAGAAGAAATTTGTAAAAGAAGAACACGATAAGAAAACCGGTCAAG

AGGGTATGACATTACTCGAAGTGATCATCGTTCTAGGCATTATGGGGGTGGTTTCGGCGGGGGTTGTTAC

TCTGGCGCAGCGTGCGATTGATTCGCAGAATATGACCAAGGCCGCGCAAAGTCTCAATAGTATCCAAGTT

GCACTGACACAGACATACCGTGGTCTAGGTAATTATCCAGCAACAGCTGATGCGACAGCTGCTAGTAAGC

TAACTTCAGGCTTGGTTAGTTTAGGTAAAATATCATCCGATGAGGCAAAAAACCCATTCATTGGTACAAA

TATGAATATTTTTTCATTTCCGCGTAATGCAGCAGCTAATAAAGCATTTGCAATTTCAGTGGATGGTCTG

ACACAGGCTCAATGCAAGACACTTATTACCAGTGTCGGTGATATGTTCCCATATATTGCAATCAAAGCTG

GTGGCGCAGTAGCACTTGCAGATCTAGGTGATTTTGAGAATTCTGCAGCAGCGGCTGAGACAGGCGTTGG

TGTGATCAAATCTATCGCTCCCGCTAGTAAGAATTTAGATCTAACGAACATCACTCACGTTGAGAAATTA

TGTAAAGGTACTGCTCCATTCGGCGTTGCATTTGGTAACAGCTAA

>gi|15825403|gb|AF414371.1| Vibrio cholerae TcpA (tcpA) gene, partial cds

TCACGATAAAGAAAACCGGTCAAGAGGGTATGACACTACTCGAAGTGATCATCGTTCTAGGTATTATGGG

CGTGGTTTCGGCGGGGGTTGTTACGCTGGCTCAGCGTGCGATTGATTCGCAGAATATGACTAAGGCTGCA

CAGAACTTAAATACTGTTCAAGTTTCTATGACTCAAACATATAGAGCATTAGGTAATTATCCAGCAACTG

CTAACATCGCAGCTGCTACGAAACTCACTTCAGGTCTTGTTTCTTTAGGTAAAATTTCCAGTGATGAGGC

GAAAAACCCATTCACTGGAACAAATATGAATATTTTTGCGTTCCCCCGAAATGGTGCTCCTAACAAGGCT

TTCGCAATCGCTGTCGATGGGTTAACTCAAGCACAGTGTAAAACACTCATTACAAGTGTCGGCGATATGT

TCCCATACGTCTTGATAAAGTCGGCAGGTACCATTGATTTTGCAGATTTGACTGACTTTGAAACAACACA

GGCCAAGGCTGCAGATGGTGTTGGTGTGATTAAATCAATTGCACCTGGTGGCACGAATCTTAATCTTACT

GAGATCGCTCACGTTGAGGCTCTATGTACTGGTACTGCTCCATTCGGCGTTGCATTTTGGGTA

>gi|16588714|gb|AF315787.1|AF315787 Vibrio mimicus toxin coregulated pilus (tcpA) gene, partial cds

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TGGTTTCGGCGGGGGTTGTTACTCTGGCGCAGCGTGCGATTGATTCGCAGAATATGACCAAGGCCGCGCA

AAGTCTCAATAGTATCCAAGTTGCACTGACACAGACATACCGTGGTCTAGGTAATTATCCAGCAACAGCT

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AAAACCCATTCATTGGTACAAATATGAATATTTTTTCATTTCCGCGTAATGCAGCAGTTAATAAAGCATT

TGCAATTTCAGTGGATGGTCTGACACAGGCTCAATGCAAGACACTTATTACCAGTGTCGGTGATATGTTC

CCATATATTGCAATCAAAGCTGGTGGCGCAGTAGCACTTGCAGATCTAGGTGATTTTGAGAATTCTGTAG

CAGCGGCTGAGACAGGCGTTGGTGTGATCAAATCTATCGCTCCCGCTAGTAAGAATTTAGATCTAACGAA

CATCACTCACGTTGAGAAATTATGTAAAGGTACTGCTCCATTCGGCGTTGCATTTGGT