nature portfolio

https://doi.org/10.1038/s41586-024-07287-2

Supplementary information

Emergence of fractal geometries in the evolution of a metabolic enzyme

In the format provided by the authors and unedited

This file contains:

Supplementary Figure 1 | Uncropped SDS-PAGE Gel images and uncropped plates from survival assays

Supplementary Figure 2 | SAXS scatter curves of extant and ancestral proteins at different protein concentrations

Supplementary Figure 3 | Cryo-EM data collection and processing schemes for SeCS

Supplementary Figure 4 | Cryo-EM data collection and processing schemes for Δ2-6 SeCS

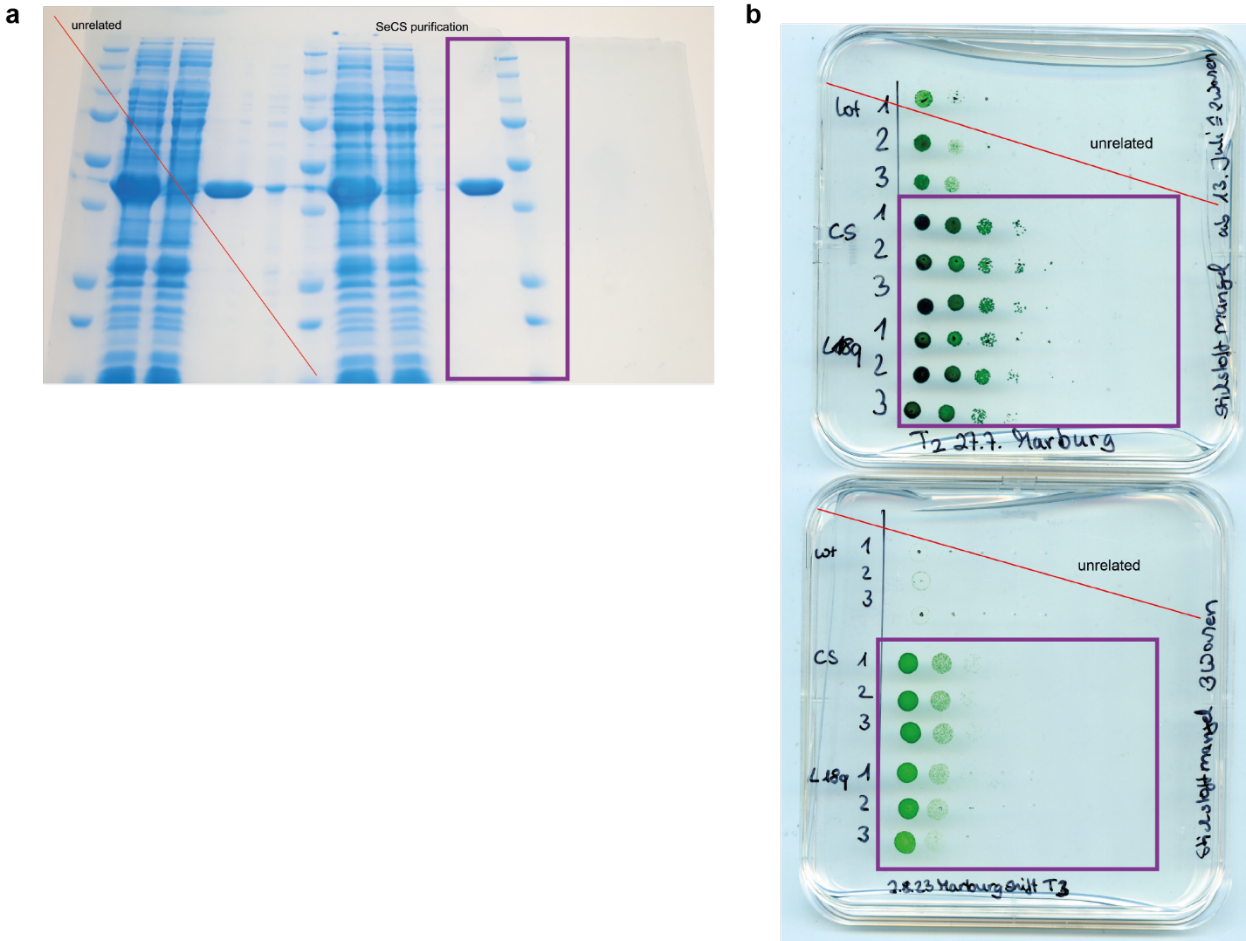
Supplementary Figure 5 | Cryo-EM data collection and processing schemes H369R SeCS

Supplementary Figure 6 | Full phylogenetic tree of CS in Cyanobacteria

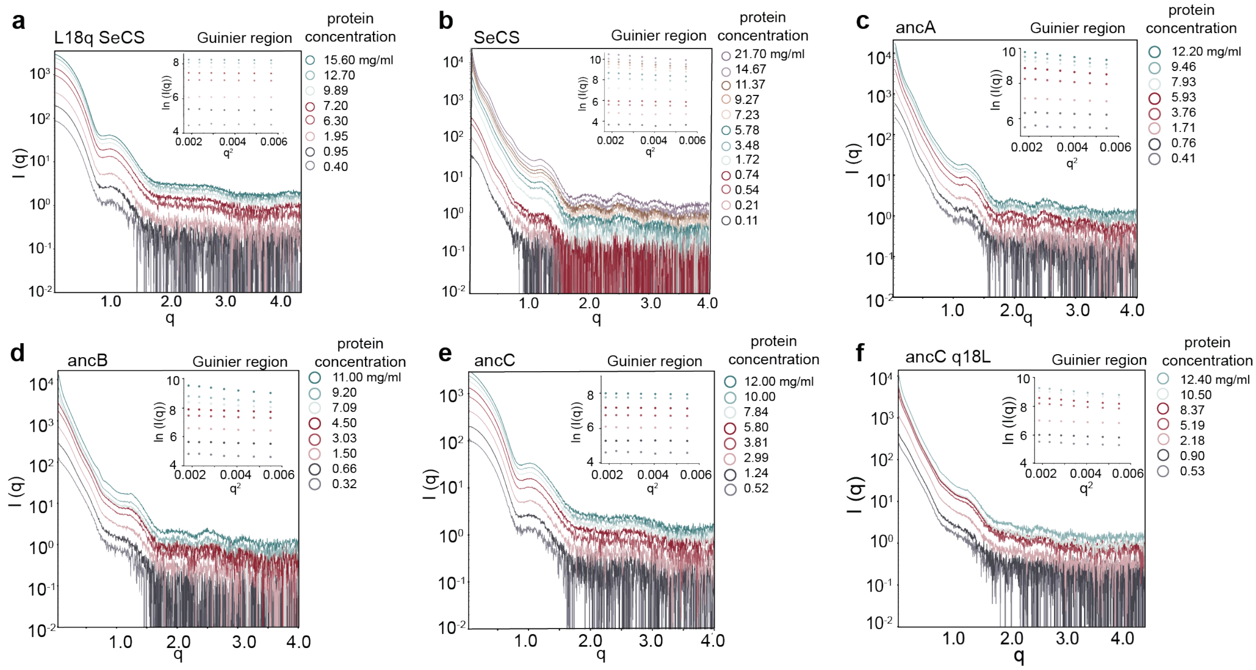
Supplementary Table 1 | Kinetic parameters for SeCS variants

Supplementary Table 2 | List and sequences of DNA sequences of proteins used in this study

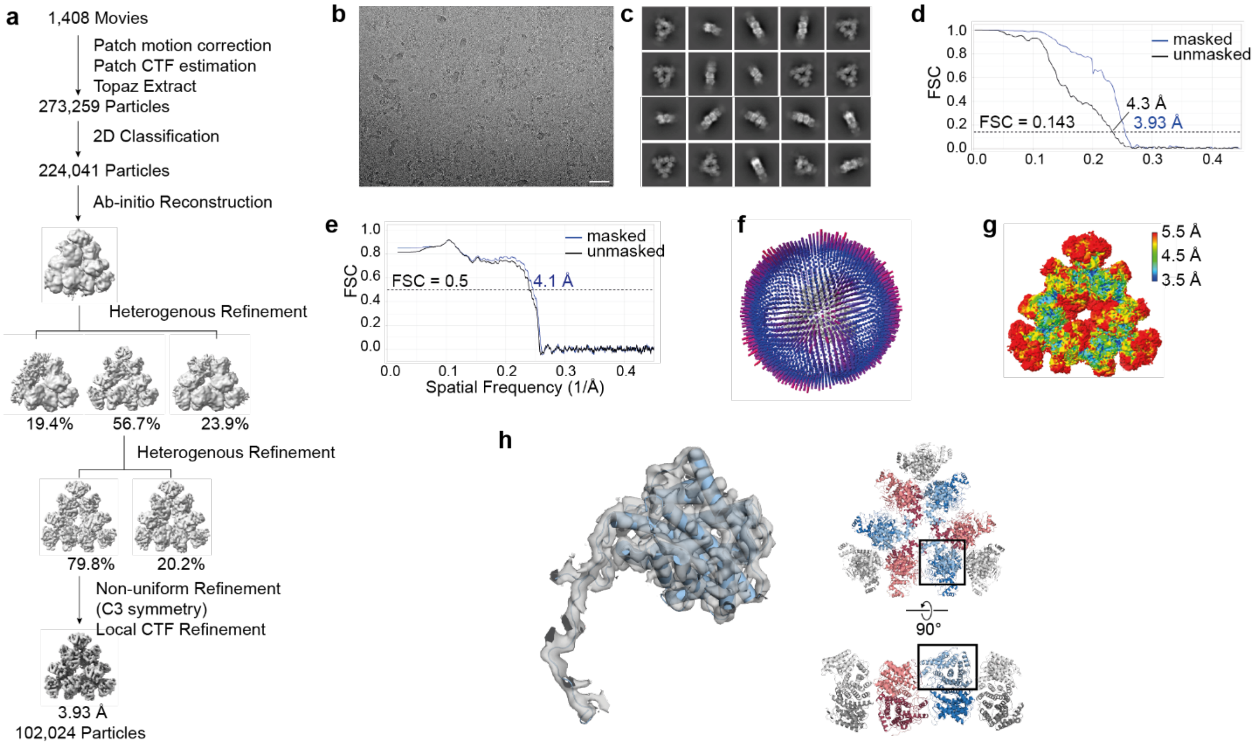
Supplementary Table 3 | List and sequences of homology cassettes used for transformation of *S. elongatus* PCC7942



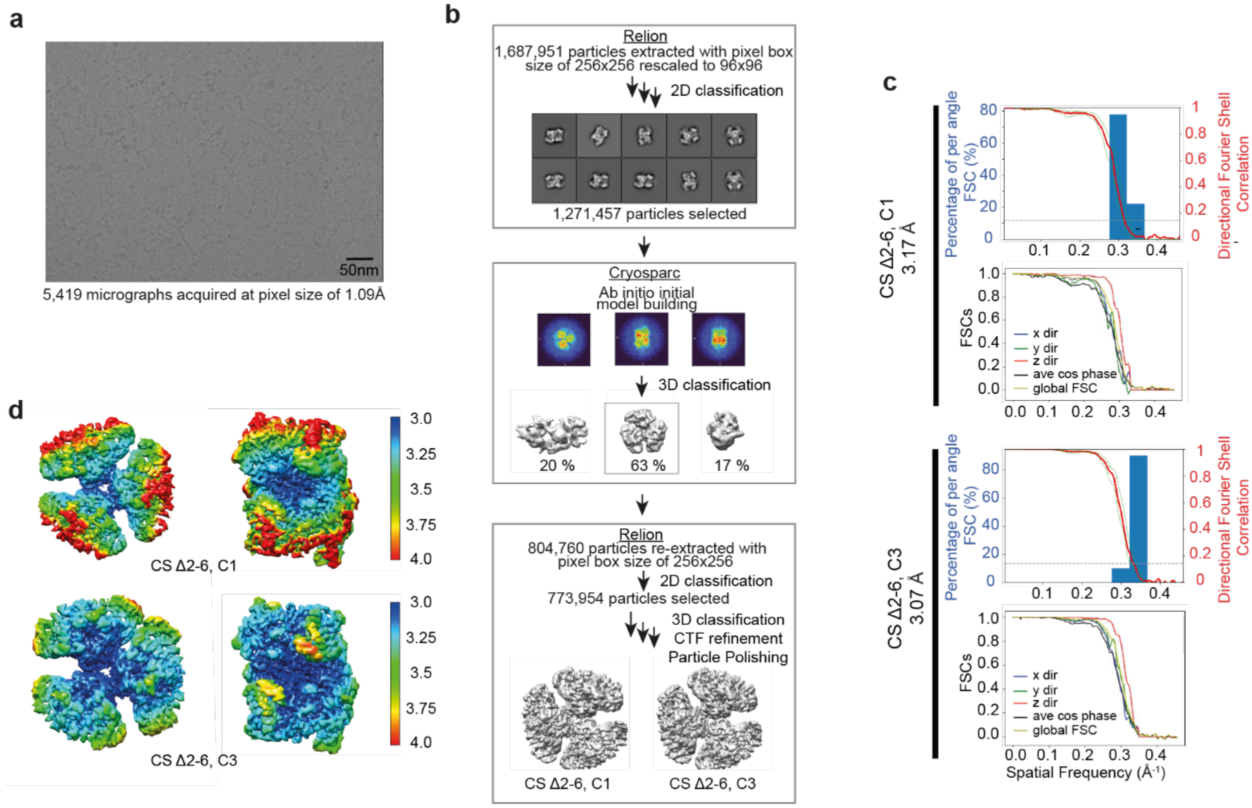
Supplementary Fig. 1 Uncropped images (**a**) SDS-PAGE of purified SeCS protein, see Extended Data Fig. 1a. (**b**) BG11-plates from survival assays of *S. elongatus* strains after extended nitrogen starvation, see Fig. 4f.



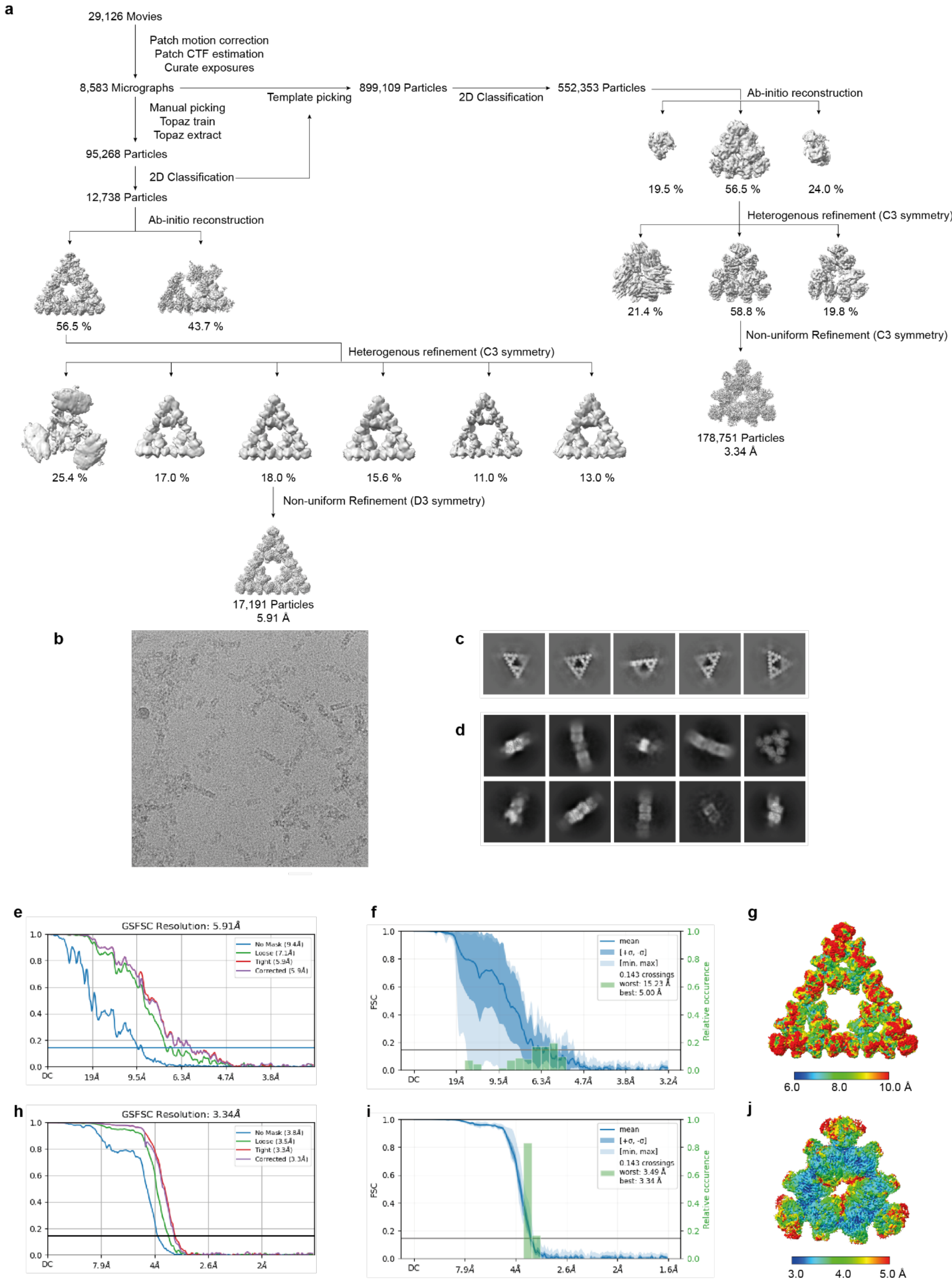
Supplementary Fig. 2 SAXS Raw scattering curves from SAXS measurements underlying the R_g measurements from (a) L18q SeCS, (b) WT SeCS, (c) ancA, (d) ancB, (e) ancC and (f) ancC q18L at indicated protein concentrations**.**



Supplementary Fig. 3 CryoEM processing workflow for the 18mer SeCS (**a**) An overview of the image processing procedure (see methods). (**b**) A representative micrograph of the SeCS (scale bar, 50 nm). 1,408 micrographs were collected it total. (**c**) Representative 2D class averages. (**d**) Fourier shell correlation (FSC) curves for the masked and unmasked reconstruction. (**e**) FSC curves for cross-validation between the summed modelling map and the final refined model with and without masking. (**f**) Euler angular distribution of particles used in the final 3D reconstruction. (**g**) Surface view of the local resolution of the reconstruction. **(h)** Cryo-EM density of a monomeric subunit forming the 18mer. The respective monomer is indicated in the full structure next to it.

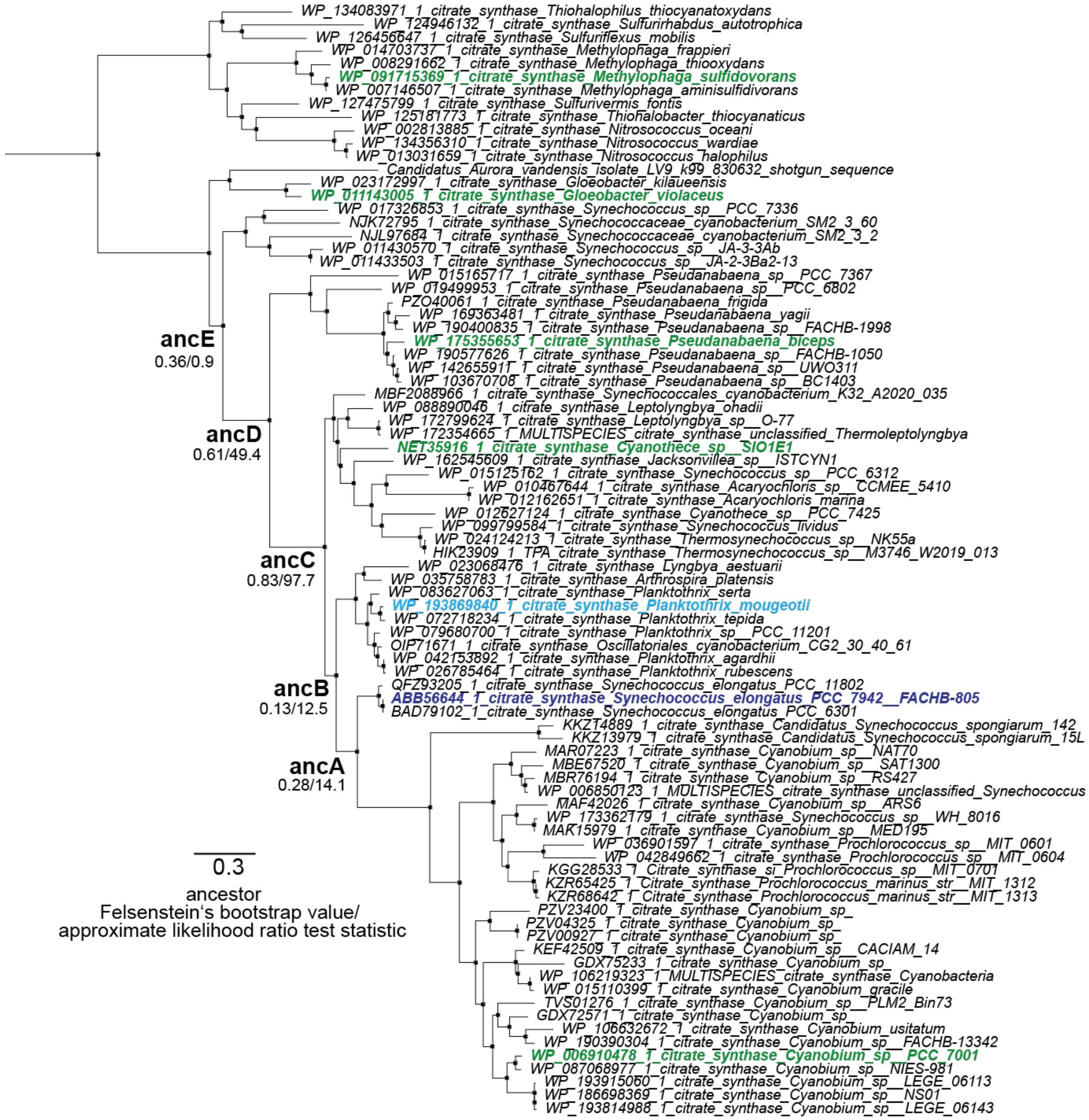


Supplementary Fig. 4 CryoEM processing workflow for the Δ2-6 SeCS (a) Example micrograph acquired on a K3 detector (Gatan, 5760x4092 pixel) showing particle distribution on Quantifoil 2/1 grid-holes. 5,419 micrographs were collected in total. **(b)** Schematic of the image processing workflow. crYOLO-picked particles were extracted and subjected to 2D classification with RELION. Selected classes were used for ab initio model building and 3D-classification in Cryosparc. Particles belonging to the 3D class reflecting 2D classification results were refined, subjected to Bayesian polishing and post-processed in RELION, once with C1 and once with C3 symmetry. **(c)** Plots showing the global and directional resolution for the densities obtained in (b), calculated using the "Remote 3DFSC Processing Server" web interface. For Δ2-6 C1 and C3 a sphericity score of 0.978 and 0.977 and a global resolution (FSC-threshold = 0.143) of 3.17 Å and of 3.07 Å was calculated, respectively. **(d)** Local resolution as calculated by RELION mapped on the refined densities (left: top view, right: side view).



Supplementary Fig. 5 CryoEM processing workflow for H369R SeCS 18mer and 54mer

(**a**) An overview of the image processing procedure (see Methods). (**b**) A representative micrograph of the SeCS 54mer acquired from Thermo Scientific Krios G4 (scale bar, 50 nm). 29,126 micrographs were collected in total. (**c**) Representative 2D classes of 54mer and (**d**) 18mer. (**e**) Fourier shell correlation (FSC) curves for the reconstruction of 54mer before and after applying various masks. (**f**) Conical FSC curves of particles used in the final 54mer 3D reconstruction. (**g**) Density map of 54mer colored by local resolution. (**h**) FSC curve of 18mer before and after applying various masks. (**i**) Conical FSC curves of particles used in the final 18mer 3D reconstruction. (**j**) Density map of 18mer colored by local resolution.



Supplementary Fig. 6 Phylogenetic tree of CS in Cyanobacteria Full tree with all sequences (organism name and NCBI-identifier) to infer the evolutionary history of SeCS. Extant sequences that were purified in vitro and analyzed regarding their assembly state are colored (blue and green). Resurrected nodes of the tree are indicated with corresponding Felsenstein's bootstrap values and approximate likelihood ratio test statistics.

Supplementary Table 1 Kinetic characterization for citrate synthase variants

	aceytlCoA		**oxaloacetate**	
	K_{cat} (s^{-1})	$K_m$acetyl-CoA (μM)	K_{cat} (s^{-1})	K_m oxaloacetate (μM)
SeCS WT	24.2 ± 1.3	91.8 ± 9.2	19.5 ± 1.7	65.6 ± 10.6
SeCS L18Q	21.7 ± 1.0	78.5 ± 6.2	20.5 ± 1.5	57.2 ± 7.8

Measurements were performed at 25 °C. N=3 biological replicates with 3 technical replicates each, errors = standard error of the mean

Supplementary Table 2 List of DNA sequences of proteins used in this study

Protein (Accession number)	DNA sequence
CS *S. elongatus* PCC 7942 GenBank: ABB56644.1	ATGACTGCCGTCAGCGAGTTTCGGCCTGGCCTAGAAGGCGTGCCCGCCACACTCTCGAGCATTAGCTTTGT CGATGGCCAGCGCGGCGTCCTAGAGTATCGCGGCATCAGCATCGAGCAACTGGCGCAACAGAGCAGTTTT CTGGAAACCGCCTACCTGTTGATTTGGGGCCATCTACCAACTCAGCAGGAATTGACCGAGTTCGAGCACGA AATTCGCTACCACCGCCGCATCAAGTTCCGCATCCGGGACATGATGAAATGCTTCCCCGATAGCGGCCATC CTATGGATGCCCTGCAGGCGAGCGCCGCAGCCCTCGGGTTGTTCTATTCGCGGCGCGCCTTGGATGATCC CGAATACATTCGGGCGGCCGTTGTGCGTTTGCTAGCCAAAATTCCGACGATGGTGGCTGCCTTCCAGCTGA TCCGCAAGGGTAACGACCCAATTCAGCCCCGCGATGAACTGGACTACGCCGCCAACTTTCTCTACATGCTG ACGGAGCGCGAGCCCGATCCAGTCGCAGCTCGGATTTTTGATATTTGCCTCACCCTGCACGCCGAACATAC GATCAACGCCTCGACCTTCTCGGCGATGGTCACAGCTTCGACCCTGACCGATCCCTACGCTGTCGTTGCTT CTGCCGTTGGCACCTTGGCTGGCCCCCTCCATGGCGGCGCCAATGAAGAAGTGCTGGACATGCTGGAGGC GATCGGTTCCGTCGAGAATGTTGAGCCCTACCTCGACCACTGCATTGCCACCAAAACGCGCATTATGGGCT TTGGGCACCGTGTCTACAAAGTCAAGGATCCGCGGGCAGTCATTCTGCAAAATCTGGCCGAGCAACTGTTC GATATCTTCGGCCATGATCCCTACTACGAAATCGCGGTCGCAGTCGAAAAGGCAGCAGCCGAGCGACTCAG CCACAAGGGCATTTACCCCAACGTCGATTTCTACTCCGGCTTGGTCTATCGCAAGCTCGGTATTCCTAGCGA TCTATTCACACCGGTGTTTGCGATCGCGCGGGTTGCGGGCTGGCTCGCCCACTGGAAAGAGCAGCTGAAC GAAAATCGGATCTTCCGCCCCACTCAGATCTACACGGGCAGCCACAACCTCGACTACACCCCGATCGCCGA TCGGGATTTGGCGATCGAATCTGAT
Δ2-5 CS *S. elongatus* PCC 7942	ATGGAGTTTCGGCCTGGCCTAGAAGGCGTGCCCGCCACACTCTCGAGCATTAGCTTTGTCGATGGCCAGCG CGGCGTCCTAGAGTATCGCGGCATCAGCATCGAGCAACTGGCGCAACAGAGCAGTTTTCTGGAAACCGCCT ACCTGTTGATTTGGGGCCATCTACCAACTCAGCAGGAATTGACCGAGTTCGAGCACGAAATTCGCTACCACC GCCGCATCAAGTTCCGCATCCGGGACATGATGAAATGCTTCCCCGATAGCGGCCATCCTATGGATGCCCTG CAGGCGAGCGCCGCAGCCCTCGGGTTGTTCTATTCGCGGCGCGCCTTGGATGATCCCGAATACATTCGGG CGGCCGTTGTGCGTTTGCTAGCCAAAATTCCGACGATGGTGGCTGCCTTCCAGCTGATCCGCAAGGGTAAC GACCCAATTCAGCCCCGCGATGAACTGGACTACGCCGCCAACTTTCTCTACATGCTGACGGAGCGCGAGCC CGATCCAGTCGCAGCTCGGATTTTTGATATTTGCCTCACCCTGCACGCCGAACATACGATCAACGCCTCGAC CTTCTCGGCGATGGTCACAGCTTCGACCCTGACCGATCCCTACGCTGTCGTTGCTTCTGCCGTTGGCACCT TGGCTGGCCCCCTCCATGGCGGCGCCAATGAAGAAGTGCTGGACATGCTGGAGGCGATCGGTTCCGTCGA GAATGTTGAGCCCTACCTCGACCACTGCATTGCCACCAAAACGCGCATTATGGGCTTTGGGCACCGTGTCT ACAAAGTCAAGGATCCGCGGGCAGTCATTCTGCAAAATCTGGCCGAGCAACTGTTCGATATCTTCGGCCAT GATCCCTACTACGAAATCGCGGTCGCAGTCGAAAAGGCAGCAGCCGAGCGACTCAGCCACAAGGGCATTT ACCCCAACGTCGATTTCTACTCCGGCTTGGTCTATCGCAAGCTCGGTATTCCTAGCGATCTATTCACACCGG TGTTTGCGATCGCGCGGGTTGCGGGCTGGCTCGCCCACTGGAAAGAGCAGCTGAACGAAAATCGGATCTT CCGCCCCACTCAGATCTACACGGGCAGCCACAACCTCGACTACACCCCGATCGCCGATCGGGATTTGGCG ATCGAATCTGAT
Δ2-6 CS *S. elongatus* PCC 7942	ATGTTTCGGCCTGGCCTAGAAGGCGTGCCCGCCACACTCTCGAGCATTAGCTTTGTCGATGGCCAGCGCG GCGTCCTAGAGTATCGCGGCATCAGCATCGAGCAACTGGCGCAACAGAGCAGTTTTCTGGAAACCGCCTAC CTGTTGATTTGGGGCCATCTACCAACTCAGCAGGAATTGACCGAGTTCGAGCACGAAATTCGCTACCACCG CCGCATCAAGTTCCGCATCCGGGACATGATGAAATGCTTCCCCGATAGCGGCCATCCTATGGATGCCCTGC AGGCGAGCGCCGCAGCCCTCGGGTTGTTCTATTCGCGGCGCGCCTTGGATGATCCCGAATACATTCGGGC GGCCGTTGTGCGTTTGCTAGCCAAAATTCCGACGATGGTGGCTGCCTTCCAGCTGATCCGCAAGGGTAACG ACCCAATTCAGCCCCGCGATGAACTGGACTACGCCGCCAACTTTCTCTACATGCTGACGGAGCGCGAGCCC GATCCAGTCGCAGCTCGGATTTTTGATATTTGCCTCACCCTGCACGCCGAACATACGATCAACGCCTCGACC TTCTCGGCGATGGTCACAGCTTCGACCCTGACCGATCCCTACGCTGTCGTTGCTTCTGCCGTTGGCACCTT GGCTGGCCCCCTCCATGGCGGCGCCAATGAAGAAGTGCTGGACATGCTGGAGGCGATCGGTTCCGTCGAG AATGTTGAGCCCTACCTCGACCACTGCATTGCCACCAAAACGCGCATTATGGGCTTTGGGCACCGTGTCTA CAAAGTCAAGGATCCGCGGGCAGTCATTCTGCAAAATCTGGCCGAGCAACTGTTCGATATCTTCGGCCATG ATCCCTACTACGAAATCGCGGTCGCAGTCGAAAAGGCAGCAGCCGAGCGACTCAGCCACAAGGGCATTTAC CCCAACGTCGATTTCTACTCCGGCTTGGTCTATCGCAAGCTCGGTATTCCTAGCGATCTATTCACACCGGTG TTTGCGATCGCGCGGGTTGCGGGCTGGCTCGCCCACTGGAAAGAGCAGCTGAACGAAAATCGGATCTTCC GCCCCACTCAGATCTACACGGGCAGCCACAACCTCGACTACACCCCGATCGCCGATCGGGATTTGGCGATC GAATCTGAT
E5A CS *S. elongatus* PCC 7942	ATGACTGCCGTCAGCGCATTTCGGCCTGGCCTAGAAGGCGTGCCCGCCACACTCTCGAGCATTAGCTTTGT CGATGGCCAGCGCGGCGTCCTAGAGTATCGCGGCATCAGCATCGAGCAACTGGCGCAACAGAGCAGTTTT CTGGAAACCGCCTACCTGTTGATTTGGGGCCATCTACCAACTCAGCAGGAATTGACCGAGTTCGAGCACGA AATTCGCTACCACCGCCGCATCAAGTTCCGCATCCGGGACATGATGAAATGCTTCCCCGATAGCGGCCATC CTATGGATGCCCTGCAGGCGAGCGCCGCAGCCCTCGGGTTGTTCTATTCGCGGCGCGCCTTGGATGATCC CGAATACATTCGGGCGGCCGTTGTGCGTTTGCTAGCCAAAATTCCGACGATGGTGGCTGCCTTCCAGCTGA TCCGCAAGGGTAACGACCCAATTCAGCCCCGCGATGAACTGGACTACGCCGCCAACTTTCTCTACATGCTG ACGGAGCGCGAGCCCGATCCAGTCGCAGCTCGGATTTTTGATATTTGCCTCACCCTGCACGCCGAACATAC GATCAACGCCTCGACCTTCTCGGCGATGGTCACAGCTTCGACCCTGACCGATCCCTACGCTGTCGTTGCTT CTGCCGTTGGCACCTTGGCTGGCCCCCTCCATGGCGGCGCCAATGAAGAAGTGCTGGACATGCTGGAGGC GATCGGTTCCGTCGAGAATGTTGAGCCCTACCTCGACCACTGCATTGCCACCAAAACGCGCATTATGGGCT TTGGGCACCGTGTCTACAAAGTCAAGGATCCGCGGGCAGTCATTCTGCAAAATCTGGCCGAGCAACTGTTC GATATCTTCGGCCATGATCCCTACTACGAAATCGCGGTCGCAGTCGAAAAGGCAGCAGCCGAGCGACTCAG CCACAAGGGCATTTACCCCAACGTCGATTTCTACTCCGGCTTGGTCTATCGCAAGCTCGGTATTCCTAGCGA TCTATTCACACCGGTGTTTGCGATCGCGCGGGTTGCGGGCTGGCTCGCCCACTGGAAAGAGCAGCTGAAC GAAAATCGGATCTTCCGCCCCACTCAGATCTACACGGGCAGCCACAACCTCGACTACACCCCGATCGCCGA TCGGGATTTGGCGATCGAATCTGAT

L18Q CS *S. elongatus* PCC 7942	ATGACTGCCGTCAGCGAGTTTCGGCCTGGCCTAGAAGGCGTGCCCGCCACACAGTCGAGCATTAGCTTTGT CGATGGCCAGCGCGGCGTCCTAGAGTATCGCGGCATCAGCATCGAGCAACTGGCGCAACAGAGCAGTTTT CTGGAAACCGCCTACCTGTTGATTTGGGGCCATCTACCAACTCAGCAGGAATTGACCGAGTTCGAGCACGA AATTCGCTACCACCGCCGCATCAAGTTCCGCATCCGGGACATGATGAAATGCTTCCCCGATAGCGGCCATC CTATGGATGCCCTGCAGGCGAGCGCCGCAGCCCTCGGGTTGTTCTATTCGCGGCGCGCCTTGGATGATCC CGAATACATTCGGGCGGCCGTTGTGCGTTTGCTAGCCAAAATTCCGACGATGGTGGCTGCCTTCCAGCTGA TCCGCAAGGGTAACGACCCAATTCAGCCCCGCGATGAACTGGACTACGCCGCCAACTTTCTCTACATGCTG ACGGAGCGCGAGCCCGATCCAGTCGCAGCTCGGATTTTTGATATTTGCCTCACCCTGCACGCCGAACATAC GATCAACGCCTCGACCTTCTCGGCGATGGTCACAGCTTCGACCCTGACCGATCCCTACGCTGTCGTTGCTT CTGCCGTTGGCACCTTGGCTGGCCCCCTCCATGGCGGCGCCAATGAAGAAGTGCTGGACATGCTGGAGGC GATCGGTTCCGTCGAGAATGTTGAGCCCTACCTCGACCACTGCATTGCCACCAAAACGCGCATTATGGGCT TTGGGCACCGTGTCTACAAAGTCAAGGATCCGCGGGCAGTCATTCTGCAAAATCTGGCCGAGCAACTGTTC GATATCTTCGGCCATGATCCCTACTACGAAATCGCGGTCGCAGTCGAAAAGGCAGCAGCCGAGCGACTCAG CCACAAGGGCATTTACCCCAACGTCGATTTCTACTCCGGCTTGGTCTATCGCAAGCTCGGTATTCCTAGCGA TCTATTCACACCGGTGTTTGCGATCGCGCGGGTTGCGGGCTGGCTCGCCCACTGGAAAGAGCAGCTGAAC GAAAATCGGATCTTCCGCCCCACTCAGATCTACACGGGCAGCCACAACCTCGACTACACCCCGATCGCCGA TCGGGATTTGGCGATCGAATCTGAT
H369R CS *S. elongatus* PCC 7942	ATGACTGCCGTCAGCGAGTTTCGGCCTGGCCTAGAAGGCGTGCCCGCCACACTCTCGAGCATTAGCTTTGT CGATGGCCAGCGCGGCGTCCTAGAGTATCGCGGCATCAGCATCGAGCAACTGGCGCAACAGAGCAGTTTT CTGGAAACCGCCTACCTGTTGATTTGGGGCCATCTACCAACTCAGCAGGAATTGACCGAGTTCGAGCACGA AATTCGCTACCACCGCCGCATCAAGTTCCGCATCCGGGACATGATGAAATGCTTCCCCGATAGCGGCCATC CTATGGATGCCCTGCAGGCGAGCGCCGCAGCCCTCGGGTTGTTCTATTCGCGGCGCGCCTTGGATGATCC CGAATACATTCGGGCGGCCGTTGTGCGTTTGCTAGCCAAAATTCCGACGATGGTGGCTGCCTTCCAGCTGA TCCGCAAGGGTAACGACCCAATTCAGCCCCGCGATGAACTGGACTACGCCGCCAACTTTCTCTACATGCTG ACGGAGCGCGAGCCCGATCCAGTCGCAGCTCGGATTTTTGATATTTGCCTCACCCTGCACGCCGAACATAC GATCAACGCCTCGACCTTCTCGGCGATGGTCACAGCTTCGACCCTGACCGATCCCTACGCTGTCGTTGCTT CTGCCGTTGGCACCTTGGCTGGCCCCCTCCATGGCGGCGCCAATGAAGAAGTGCTGGACATGCTGGAGGC GATCGGTTCCGTCGAGAATGTTGAGCCCTACCTCGACCACTGCATTGCCACCAAAACGCGCATTATGGGCT TTGGGCACCGTGTCTACAAAGTCAAGGATCCGCGGGCAGTCATTCTGCAAAATCTGGCCGAGCAACTGTTC GATATCTTCGGCCATGATCCCTACTACGAAATCGCGGTCGCAGTCGAAAAGGCAGCAGCCGAGCGACTCAG CCACAAGGGCATTTACCCCAACGTCGATTTCTACTCCGGCTTGGTCTATCGCAAGCTCGGTATTCCTAGCGA TCTATTCACACCGGTGTTTGCGATCGCGCGGGTTGCGGGCTGGCTCGCCCACTGGAAAGAGCAGCTGAAC GAAAATCGGATCTTCCGCCCCACTCAGATCTACACGGGCAGCCGCAACCTCGACTACACCCCGATCGCCGA TCGGGATTTGGCGATCGAATCTGAT
Cys4 CS *S. elongatus* PCC 7942	ATGACTGCCTGCAGCGAGTTTCGGCCTGGCCTAGAAGGCGTGCCCGCCACACTCTCGAGCATTAGCTTTGT CGATGGCCAGCGCGGCGTCCTAGAGTATCGCGGCATCAGCATCGAGCAACTGGCGCAACAGAGCAGTTTT CTGGAAACCGCCTACCTGTTGATTTGGGGCCATCTACCAACTCAGCAGGAATTGACCGAGTTCGAGCACGA AATTCGCTACCACCGCCGCATCAAGTTCCGCATCCGGGACATGATGAAATGCTTCCCCGATAGCGGCCATC CTATGGATGCCCTGCAGGCGAGCGCCGCAGCCCTCGGGTTGTTCTATTCGCGGCGCGCCTTGGATGATCC CGAATACATTCGGGCGGCCGTTGTGCGTTTGCTAGCCAAAATTCCGACGATGGTGGCTGCCTTCCAGCTGA TCCGCAAGGGTAACGACCCAATTCAGCCCCGCGATGAACTGGACTACGCCGCCAACTTTCTCTACATGCTG ACGGAGCGCGAGCCCGATCCAGTCGCAGCTCGGATTTTTGATATTTGCCTCACCCTGCACGCCGAACATAC GATCAACGCCTCGACCTTCTCGGCGATGGTCACAGCTTCGACCCTGACCGATCCCTACGCTGTCGTTGCTT CTGCCGTTGGCACCTTGGCTGGCCCCCTCCATGGCGGCGCCAATGAAGAAGTGCTGGACATGCTGGAGGC GATCGGTTCCGTCGAGAATGTTGAGCCCTACCTCGACCACTGCATTGCCACCAAAACGCGCATTATGGGCT TTGGGCACCGTGTCTACAAAGTCAAGGATCCGCGGGCAGTCATTCTGCAAAATCTGGCCGAGCAACTGTTC GATATCTTCGGCCATGATCCCTACTACGAAATCGCGGTCGCAGTCGAAAAGGCAGCAGCCGAGCGACTCAG CCACAAGGGCATTTACCCCAACGTCGATTTCTACTCCGGCTTGGTCTATCGCAAGCTCGGTATTCCTAGCGA TCTATTCACACCGGTGTTTGCGATCGCGCGGGTTGCGGGCTGGCTCGCCCACTGGAAAGAGCAGCTGAAC GAAAATCGGATCTTCCGCCCCACTCAGATCTACACGGGCAGCCACAACCTCGACTACACCCCGATCGCCGA TCGGGATTTGGCGATCGAATCTGAT
CS *Synechocystis* PCC 6803 NCBI Reference Sequence: WP_010873488.1	ATGAATTATATGATGACTGATAACGAAGTGTTTAAAGAAGGCCTAGCCGGAGTCCCCGCCGCTAAATCGAGG GTGAGCCATGTGGATGGCACCGACGGTATTTTGGAGTACCGGGGCATTCGCATCGAAGAATTAGCCAAATC CAGTAGTTTTATCGAAGTAGCCTATCTGCTCATCTGGGGTAAATTGCCCACCCAGGCAGAGATCGAAGAGTT TGAGTACGAAATTCGCACCCATCGACGCATTAAGTACCACATCCGGGACATGATGAAATGTTTTCCCGAAAC AGGGCACCCCATGGATGCCTTGCAAACTTCAGCGGCGGCCTTGGGATTGTTCTATGCTCGACGGGCCTTGG ATGACCCCAAATATATCCGGGCGGCGGTGGTGCGTCTGTTAGCCAAAATCCCCACCATGGTGGCAGCTTTC CACATGATCCGGGAGGGTAACGATCCCATTCAGCCCAATGATAAATTGGATTACGCTTCCAACTTCCTTTAC ATGCTGACGGAGAAGGAGCCAGACCCCTTTGCCGCCAAAGTGTTTGATGTGTGTTTGACCCTCCATGCTGA GCACACCATGAATGCGTCCACCTTTTCGGCCCGGGTAACGGCTTCTACTCTCACGGATCCCTATGCAGTGG TTGCCTCGGCGGTGGGGACTTTGGCGGGGCCGCTCCACGGGGGAGCCAACGAAGAAGTGCTAAATATGCT TGAAGAAATTGGCTCAGTGGAAAATGTCCGCCCCTACGTGGAAAAATGCCTGGCCAACAAACAGCGCATCA TGGGCTTTGGCCACCGAGTTTATAAAGTCAAAGACCCCCGGGCAATTATTTTGCAGGATTTGGCTGAACAGT TATTTGCCAAAATGGGCCACGACGAATATTACGAAATCGCAGTGGAGTTGGAAAAAGTAGTGGAAGAATACG TGGGTCAAAAGGGCATTTACCCCAATGTGGACTTCTATTCCGGTTTGGTTTACCGCAAGCTAGACATCCCCG CCGATCTGTTTACGCCCCTATTTGCGATCGCCAGGGTGGCGGGTTGGTTGGCCCACTGGAAGGAACAATTA TCAGTCAATAAAATTTACCGTCCTACCCAAATTTACATCGGTGACCATAATTTATCTTATGTTCCCATGACAGA ACGGGTAGTTTCCGTGGCCCGCAATGAAGACCCCAATGCGATTATT
ancA	ATGACTGCCGTATCCGAGTTTCGTCCAGGGCTTGAGGGAGTACCTGCAACTTTGAGCTCGATCAGTTTTGTG GACGGGCAACGCGGTGTACTTGAATATCGTGGGATTTCCATCGAGCAACTGGCGCAACATTCTTCTTTTCTT GAGACTGCCTATTTACTGATCTGGGGCCATCTTCCGACTCAAGAAGAGCTTACGGAGTTCGAGCATGAGATC CGTTATCATCGTCGTATTAAATTTCGCATCCGTGACATGATGAAATGTTTTCCTGAGTCAGGGCACCCGATG GACGCTTTACAGGCTTCTGCTGCCGCTTTGGGACTTTTCTACTCTCGCCGCGCTTTGGACGACCCAGAATAT ATTCGTGCAGCAGTTGTTCGTCTGTTAGCTAAAATCCCAACAATGGTCGCGGCATTCCAACTTATTCGTAAAG GAAATGATCCGATCCAGCCTCGCGACGACCTGGATTATGCCGCTAATTTCTTATACATGCTTACAGAACGCG AGCCGGACCCTCTTGCCGCACGCATCTTTGACGTCTGTCTTACCCTTCACGCTGAACACACTATTAACGCAT CTACCTTTTCAGCCATGGTTACAGCATCCACTCTTACAGACCCTTATGCCGTAGTGGCTTCAGCCGTCGGGA CGCTTGCCGGCCCATTGCACGGTGGGGCTAATGAGGAAGTTCTTGACATGCTGGAAGAGATTGGTAGCGTC GAAAATGTTGAGCCGTATTTAGATCATTGCATTGCAAAGAAAACCAAGATTATGGGCTTCGGTCACCGCGTA TATAAAGTAAAAGATCCACGTGCTGTAATCTTGCAGAACCTTGCCGAGCAACTGTTTGATAAATTTGGTCACG ATCCGTACTATGAAATTGCCGTAGCCTTAGAGAAGGCCGCGGCCGAGCGTCTGGGACATAAGGGCATCTAT

	CCAAACGTTGATTTTTATTCTGGGCTTGTGTATCGCAAATTAGGAATCCCGTCCGACCTTTTTACTCCGGTCT TCGCAATCGCGCGTGTTGCCGGGTGGCTGGCACACTGGAAAGAGCAGTTGAATGAGAACCGTATTTTCCGC CCTACACAAATCTACACAGGTAGCCATAATCTGAATTATGTCCCGATCGAGGAACGCGATTTGGCGATCGAA TCTGAT
ancA L18q	ATGACTGCCGTATCCGAGTTTCGTCCAGGGCTTGAGGGAGTACCTGCAACTCAGAGCTCGATCAGTTTTGT GGACGGGCAACGCGGTGTACTTGAATATCGTGGGATTTCCATCGAGCAACTGGCGCAACATTCTTCTTTTCT TGAGACTGCCTATTTACTGATCTGGGGCCATCTTCCGACTCAAGAAGAGCTTACGGAGTTCGAGCATGAGAT CCGTTATCATCGTCGTATTAAATTTCGCATCCGTGACATGATGAAATGTTTTCCTGAGTCAGGGCACCCGAT GGACGCTTTACAGGCTTCTGCTGCCGCTTTGGGACTTTTCTACTCTCGCCGCGCTTTGGACGACCCAGAATA TATTCGTGCAGCAGTTGTTCGTCTGTTAGCTAAAATCCCAACAATGGTCGCGGCATTCCAACTTATTCGTAAA GGAAATGATCCGATCCAGCCTCGCGACGACCTGGATTATGCCGCTAATTTCTTATACATGCTTACAGAACGC GAGCCGGACCCTCTTGCCGCACGCATCTTTGACGTCTGTCTTACCCTTCACGCTGAACACACTATTAACGCA TCTACCTTTTCAGCCATGGTTACAGCATCCACTCTTACAGACCCTTATGCCGTAGTGGCTTCAGCCGTCGGG ACGCTTGCCGGCCCATTGCACGGTGGGGCTAATGAGGAAGTTCTTGACATGCTGGAAGAGATTGGTAGCGT CGAAAATGTTGAGCCGTATTTAGATCATTGCATTGCAAAGAAAACCAAGATTATGGGCTTCGGTCACCGCGT ATATAAAGTAAAAGATCCACGTGCTGTAATCTTGCAGAACCTTGCCGAGCAACTGTTTGATAAATTTGGTCAC GATCCGTACTATGAAATTGCCGTAGCCTTAGAGAAGGCCGCGGCCGAGCGTCTGGGACATAAGGGCATCTA TCCAAACGTTGATTTTTATTCTGGGCTTGTGTATCGCAAATTAGGAATCCCGTCCGACCTTTTTACTCCGGTC TTCGCAATCGCGCGTGTTGCCGGGTGGCTGGCACACTGGAAAGAGCAGTTGAATGAGAACCGTATTTTCCG CCCTACACAAATCTACACAGGTAGCCATAATCTGAATTATGTCCCGATCGAGGAACGCGATTTGGCGATCGA ATCTGAT
AltaII ancA	ATGACAGCGGTTTCGGAATTCCGTCCAGGTCTTGAGGGAGTTCCAGCGACGCAGTCATCCATTTCTTACGTA GATGGACAAAAGGGTATCTTAGAATATCGCGGGATCAGCATCGAACAGCTGGCACAGCAATCCTCATTCCTT GAAACCGCCTACCTTTTAATTTGGGGTAAACTTCCAACGCAACAGGAGCTGGCAGAGTTTGAACACGAAATT CGTTACCACCGTCGCATCAAGTTCCGTATCCGTGATATGATGAAATGTTTCCCCGATTCTGGGCACCCCATG GATGCACTTCAGGCTTCAGCCGCCGCGCTTGGCCTTTTTTACAGTCGTCGCGCTCTTGACGACCCGGAATA CATTCGTGCAGCCGTTGTGCGCCTGCTGGCCAAGATCCCCACTATGGTTGCCGCATTTCAGTTAATCCGCA AGGGTAATGATCCGATCCAGCCACGTGATGATCTGGATTACGCTGCGAACTTTCTTTACATGTTAACAGAGC GTGAGCCAGATCCTCTGGCTGCCCGTATTTTCGATGTTTGTTTAACTTTGCACGCAGAACACACTATCAATG CAAGTACCTTTTCAGCTATGGTTACGGCCTCTACCCTGACCGATCCATATGCTGTCGTAGCGTCTGCAGTTG GGACGCTGGCGGGACCTCTTCATGGGGGCGCAAATGAAGAGGTACTTACAATGTTGGAAGAGATTGGAAGT GTCGAGAACGTAGAGCCGTACTTGGACCACTGCATTGCACGCAAGGCGCGCATCATGGGGTTCGGTCACC GCGTGTACAAAGTAAAAGACCCTCGTGCTGTCATTCTTCAGAACCTGGCTGAGCAACTTTTTGAGCGTTTTG GTCACGACCCATATTACGACATCGCGTTAGCATTGGAACGTGCAGTCGCCGAACGCCTGGGCCACAAGGG GATTTATCCAAACGTCGACTTTTACTCAGGACTTGTGTATCGCAAACTTGGTATCCCTTCAGACTTATTTACA CCCGTTTTCGCTATCGCACGTGTTGCAGGGTGGCTTGCCCATTGGAAGGAACAGTTATCAGAAAATCGCATT TTTCGCCCCACGCAAATTTATACAGGTAGTCACAACATGGATTATACACCAATTGAGGAGCGTGATTTGGCG ATCGAATCTGAT
AltaII ancA L18q	ATGACAGCGGTTTCGGAATTCCGTCCAGGTCTTGAGGGAGTTCCAGCGACGCTCTCATCCATTTCTTACGTA GATGGACAAAAGGGTATCTTAGAATATCGCGGGATCAGCATCGAACAGCTGGCACAGCAATCCTCATTCCTT GAAACCGCCTACCTTTTAATTTGGGGTAAACTTCCAACGCAACAGGAGCTGGCAGAGTTTGAACACGAAATT CGTTACCACCGTCGCATCAAGTTCCGTATCCGTGATATGATGAAATGTTTCCCCGATTCTGGGCACCCCATG GATGCACTTCAGGCTTCAGCCGCCGCGCTTGGCCTTTTTTACAGTCGTCGCGCTCTTGACGACCCGGAATA CATTCGTGCAGCCGTTGTGCGCCTGCTGGCCAAGATCCCCACTATGGTTGCCGCATTTCAGTTAATCCGCA AGGGTAATGATCCGATCCAGCCACGTGATGATCTGGATTACGCTGCGAACTTTCTTTACATGTTAACAGAGC GTGAGCCAGATCCTCTGGCTGCCCGTATTTTCGATGTTTGTTTAACTTTGCACGCAGAACACACTATCAATG CAAGTACCTTTTCAGCTATGGTTACGGCCTCTACCCTGACCGATCCATATGCTGTCGTAGCGTCTGCAGTTG GGACGCTGGCGGGACCTCTTCATGGGGGCGCAAATGAAGAGGTACTTACAATGTTGGAAGAGATTGGAAGT GTCGAGAACGTAGAGCCGTACTTGGACCACTGCATTGCACGCAAGGCGCGCATCATGGGGTTCGGTCACC GCGTGTACAAAGTAAAAGACCCTCGTGCTGTCATTCTTCAGAACCTGGCTGAGCAACTTTTTGAGCGTTTTG GTCACGACCCATATTACGACATCGCGTTAGCATTGGAACGTGCAGTCGCCGAACGCCTGGGCCACAAGGG GATTTATCCAAACGTCGACTTTTACTCAGGACTTGTGTATCGCAAACTTGGTATCCCTTCAGACTTATTTACA CCCGTTTTCGCTATCGCACGTGTTGCAGGGTGGCTTGCCCATTGGAAGGAACAGTTATCAGAAAATCGCATT TTTCGCCCCACGCAAATTTATACAGGTAGTCACAACATGGATTATACACCAATTGAGGAGCGTGATTTGGCG ATCGAATCTGAT
ancB	ATGACGGCTGTCTCCGAGTTTAAGCCTGGACTTGAGGGTGTGCCCGCTACTCTGAGTTCTATTTCCTTCGTC GACGGCCAGCGCGGGATTCTGGAATACCGTGGGATTAGTATTGAGCAATTAGCCCAACATTCGACATTTCTT GAGACAGCGTATTTACTGATTTGGGGTAAACTTCCCACCCAAGAGGAATTAGCAGAATTCGAACATGAAATT CGCTACCATCGCCGTATCAAGTACCGTATTCGTGATATGATGAAGTGCTTCCCAGAGTCAGGTCACCCAATG GATGCTTTGCAAGCCTCAGCAGCGGCCTTGGGGTTGTTCTATTCGCGTCGTGCGCTGGACGACCCCGAGTA CATCCGTGCGGCAGTTGTGCGTTTACTGGCCAAGATTCCGACAATGGTTGCAGCATTCCAACTTATGCGCAA AGGAAACGACCCGGTACAACCGCGTGATGATCTGGATTATGCGGCTAACTTCTTGTACATGTTAAACGAACG TGAGCCAGATCCGCTGGCCGCACGCATCTTCGACGTATGCCTTACGCTGCATGCGGAACATACTATCAACG CCTCCACGTTCTCGGCAATGGTAACGGCGTCTACTTTAACTGACCCTTACGCAGTAGTAGCATCGGCTGTAG GGACGTTAGCCGGCCCGTTACATGGAGGTGCAAACGAGGAGGTTTTGACAATGTTGGAGGAGATTGGCAG TGTTGAGAACGTCCGTCCGTACTTAGACCATTGTATCGCGAAAAAGGCCAAGATCATGGGGTTCGGACACC GCGTGTATAAAGTAAAGGATCCTCGTGCGACAATTTTACAAAATTTAGCAGAGCAGTTATTTGAGAAATTTGG TCACGATCAGTATTATGAAATCGCACTGGAATTAGAGCGTGTAGTCGCTGAACGCCTTGGTCATAAAGGGAT TTATCCGAACGTCGATTTTTATTCTGGATTGGTATACCGTAAATTAGGCATTCCATCGGATTTATTCACTCCG GTATTTGCCATCGCACGCGTGGCAGGTTGGTTGGCCCACTGGAAAGAACAATTGTCCGAAAATCGCATCTT CCGTCCAACCCAAATTTATACTGGATCACATAATATGACTTACGTGCCAATCGAAGAACGTGATTTGGCGAT CGAATCTGAT
ancB k8R	ATGACGGCTGTCTCCGAGTTTCGTCCTGGACTTGAGGGTGTGCCCGCTACTCTGAGTTCTATTTCCTTCGTC GACGGCCAGCGCGGGATTCTGGAATACCGTGGGATTAGTATTGAGCAATTAGCCCAACATTCGACATTTCTT GAGACAGCGTATTTACTGATTTGGGGTAAACTTCCCACCCAAGAGGAATTAGCAGAATTCGAACATGAAATT CGCTACCATCGCCGTATCAAGTACCGTATTCGTGATATGATGAAGTGCTTCCCAGAGTCAGGTCACCCAATG GATGCTTTGCAAGCCTCAGCAGCGGCCTTGGGGTTGTTCTATTCGCGTCGTGCGCTGGACGACCCCGAGTA CATCCGTGCGGCAGTTGTGCGTTTACTGGCCAAGATTCCGACAATGGTTGCAGCATTCCAACTTATGCGCAA AGGAAACGACCCGGTACAACCGCGTGATGATCTGGATTATGCGGCTAACTTCTTGTACATGTTAAACGAACG TGAGCCAGATCCGCTGGCCGCACGCATCTTCGACGTATGCCTTACGCTGCATGCGGAACATACTATCAACG CCTCCACGTTCTCGGCAATGGTAACGGCGTCTACTTTAACTGACCCTTACGCAGTAGTAGCATCGGCTGTAG

	GGACGTTAGCCGGCCCGTTACATGGAGGTGCAAACGAGGAGGTTTTGACAATGTTGGAGGAGATTGGCAG TGTTGAGAACGTCCGTCCGTACTTAGACCATTGTATCGCGAAAAAGGCCAAGATCATGGGGTTCGGACACC GCGTGTATAAAGTAAAGGATCCTCGTGCGACAATTTTACAAAATTTAGCAGAGCAGTTATTTGAGAAATTTGG TCACGATCAGTATTATGAAATCGCACTGGAATTAGAGCGTGTAGTCGCTGAACGCCTTGGTCATAAAGGGAT TTATCCGAACGTCGATTTTTATTCTGGATTGGTATACCGTAAATTAGGCATTCCATCGGATTTATTCACTCCG GTATTTGCCATCGCACGCGTGGCAGGTTGGTTGGCCCACTGGAAAGAACAATTGTCCGAAAATCGCATCTT CCGTCCAACCCAAATTTATACTGGATCACATAATATGACTTACGTGCCAATCGAAGAACGTGATTTGGCGAT CGAATCTGAT
ancB y80F	ATGACGGCTGTCTCCGAGTTTAAGCCTGGACTTGAGGGTGTGCCCGCTACTCTGAGTTCTATTTCCTTCGTC GACGGCCAGCGCGGGATTCTGGAATACCGTGGGATTAGTATTGAGCAATTAGCCCAACATTCGACATTTCTT GAGACAGCGTATTTACTGATTTGGGGTAAACTTCCCACCCAAGAGGAATTAGCAGAATTCGAACATGAAATT CGCTACCATCGCCGTATCAAGTTCCGTATTCGTGATATGATGAAGTGCTTCCCAGAGTCAGGTCACCCAATG GATGCTTTGCAAGCCTCAGCAGCGGCCTTGGGGTTGTTCTATTCGCGTCGTGCGCTGGACGACCCCGAGTA CATCCGTGCGGCAGTTGTGCGTTTACTGGCCAAGATTCCGACAATGGTTGCAGCATTCCAACTTATGCGCAA AGGAAACGACCCGGTACAACCGCGTGATGATCTGGATTATGCGGCTAACTTCTTGTACATGTTAAACGAACG TGAGCCAGATCCGCTGGCCGCACGCATCTTCGACGTATGCCTTACGCTGCATGCGGAACATACTATCAACG CCTCCACGTTCTCGGCAATGGTAACGGCGTCTACTTTAACTGACCCTTACGCAGTAGTAGCATCGGCTGTAG GGACGTTAGCCGGCCCGTTACATGGAGGTGCAAACGAGGAGGTTTTGACAATGTTGGAGGAGATTGGCAG TGTTGAGAACGTCCGTCCGTACTTAGACCATTGTATCGCGAAAAAGGCCAAGATCATGGGGTTCGGACACC GCGTGTATAAAGTAAAGGATCCTCGTGCGACAATTTTACAAAATTTAGCAGAGCAGTTATTTGAGAAATTTGG TCACGATCAGTATTATGAAATCGCACTGGAATTAGAGCGTGTAGTCGCTGAACGCCTTGGTCATAAAGGGAT TTATCCGAACGTCGATTTTTATTCTGGATTGGTATACCGTAAATTAGGCATTCCATCGGATTTATTCACTCCG GTATTTGCCATCGCACGCGTGGCAGGTTGGTTGGCCCACTGGAAAGAACAATTGTCCGAAAATCGCATCTT CCGTCCAACCCAAATTTATACTGGATCACATAATATGACTTACGTGCCAATCGAAGAACGTGATTTGGCGAT CGAATCTGAT
ancB k8R, y80F	ATGACGGCTGTCTCCGAGTTTCGTCCTGGACTTGAGGGTGTGCCCGCTACTCTGAGTTCTATTTCCTTCGTC GACGGCCAGCGCGGGATTCTGGAATACCGTGGGATTAGTATTGAGCAATTAGCCCAACATTCGACATTTCTT GAGACAGCGTATTTACTGATTTGGGGTAAACTTCCCACCCAAGAGGAATTAGCAGAATTCGAACATGAAATT CGCTACCATCGCCGTATCAAGTTCCGTATTCGTGATATGATGAAGTGCTTCCCAGAGTCAGGTCACCCAATG GATGCTTTGCAAGCCTCAGCAGCGGCCTTGGGGTTGTTCTATTCGCGTCGTGCGCTGGACGACCCCGAGTA CATCCGTGCGGCAGTTGTGCGTTTACTGGCCAAGATTCCGACAATGGTTGCAGCATTCCAACTTATGCGCAA AGGAAACGACCCGGTACAACCGCGTGATGATCTGGATTATGCGGCTAACTTCTTGTACATGTTAAACGAACG TGAGCCAGATCCGCTGGCCGCACGCATCTTCGACGTATGCCTTACGCTGCATGCGGAACATACTATCAACG CCTCCACGTTCTCGGCAATGGTAACGGCGTCTACTTTAACTGACCCTTACGCAGTAGTAGCATCGGCTGTAG GGACGTTAGCCGGCCCGTTACATGGAGGTGCAAACGAGGAGGTTTTGACAATGTTGGAGGAGATTGGCAG TGTTGAGAACGTCCGTCCGTACTTAGACCATTGTATCGCGAAAAAGGCCAAGATCATGGGGTTCGGACACC GCGTGTATAAAGTAAAGGATCCTCGTGCGACAATTTTACAAAATTTAGCAGAGCAGTTATTTGAGAAATTTGG TCACGATCAGTATTATGAAATCGCACTGGAATTAGAGCGTGTAGTCGCTGAACGCCTTGGTCATAAAGGGAT TTATCCGAACGTCGATTTTTATTCTGGATTGGTATACCGTAAATTAGGCATTCCATCGGATTTATTCACTCCG GTATTTGCCATCGCACGCGTGGCAGGTTGGTTGGCCCACTGGAAAGAACAATTGTCCGAAAATCGCATCTT CCGTCCAACCCAAATTTATACTGGATCACATAATATGACTTACGTGCCAATCGAAGAACGTGATTTGGCGAT CGAATCTGAT
AltaII ancB	ATGACGACTGTGTCAGAATTTAAACCGGGATTAGAGGGAGTCCCAGCAACGCAATCATCCATCTCATACGTC GACGGCCAGAAGGGGATCCTGGAATATCGTGGTATTTCTATCGAGGAGCTTGCTAAACAGAGCACCTTTCTT GAGACAGCTTACTTGCTTATCTGGGGAAAACTGCCGACTCAAGACGAATTGACCGATTTCGAACATGAGATC CGTTACCATCGTCGCATCAAATACCGCATTCGCGATATGATGAAATGTTTCCCGGAGAGTGGTCACCCGATG GATGCGTTACAAACAAGCGCAGCCGCGCTGGGACTGTTCTACTCGCGCCGTGCCCTGGATGACCCTGAATA TATCCGCGCTGCGGTCGTGCGCCTGTTGGCTAAGATTCCGACTATGGTGGCTGCATTTCAACTTATGCGTAA AGGGAATGACCCGGTCCAGCCACGTGACGATCTGGACTATGCCGCAAATTTCTTATACATGCTGAACGAGC GTGAGCCCGATCCCTTAGCCGCCCGCATTTTCGATGTGTGCCTGACTTTACATGCAGAACACACTATTAATG CCAGCACGTTCTCAGCTATGGTGACAGCATCCACTTTGACTGACCCATACGCTGTCGTGGCATCGGCAGTC GGAACACTGGCAGGTCCCCTTCATGGCGGCGCTAATGAAGAGGTATTGACGATGTTAGAAGAAATCGGGTC TGTTGAAAATGTACGTCCGTATCTGGATCACTGCATCGCTCGCAAGAGCAAGATCATGGGATTCGGCCACC GTGTATATAAGGTGAAGGATCCGCGCGCTACGATTTTACAGAATTTAGCGGAGCAATTATTTGAGAAATTCG GCCACGATCCATACTATGATATTGCCGTCGAGCTTGAGAAAGTGGTTGCGGAGCGCTTGGGTCACAAAGGG ATCTATCCTAATGTAGACTTTTATAGTGGTTTGGTTTATCGTAAACTTGGTATTCCGACTGATCTGTTTACTCC CATCTTTGCTATTGCACGCGTGGCGGGATGGTTGGCTCACTGGAAGGAACAGTTAAGTGAGAATCGTATCTT TCGCCCGACGCAAATCTATACTGGATCTCACAACATGCCTTACATCCCCATCGAAGAGCGTGATTTGGCGAT CGAATCTGAT
AltaII ancB q18L	ATGACGACTGTGTCAGAATTTAAACCGGGATTAGAGGGAGTCCCAGCAACGCTGTCATCCATCTCATACGTC GACGGCCAGAAGGGGATCCTGGAATATCGTGGTATTTCTATCGAGGAGCTTGCTAAACAGAGCACCTTTCTT GAGACAGCTTACTTGCTTATCTGGGGAAAACTGCCGACTCAAGACGAATTGACCGATTTCGAACATGAGATC CGTTACCATCGTCGCATCAAATACCGCATTCGCGATATGATGAAATGTTTCCCGGAGAGTGGTCACCCGATG GATGCGTTACAAACAAGCGCAGCCGCGCTGGGACTGTTCTACTCGCGCCGTGCCCTGGATGACCCTGAATA TATCCGCGCTGCGGTCGTGCGCCTGTTGGCTAAGATTCCGACTATGGTGGCTGCATTTCAACTTATGCGTAA AGGGAATGACCCGGTCCAGCCACGTGACGATCTGGACTATGCCGCAAATTTCTTATACATGCTGAACGAGC GTGAGCCCGATCCCTTAGCCGCCCGCATTTTCGATGTGTGCCTGACTTTACATGCAGAACACACTATTAATG CCAGCACGTTCTCAGCTATGGTGACAGCATCCACTTTGACTGACCCATACGCTGTCGTGGCATCGGCAGTC GGAACACTGGCAGGTCCCCTTCATGGCGGCGCTAATGAAGAGGTATTGACGATGTTAGAAGAAATCGGGTC TGTTGAAAATGTACGTCCGTATCTGGATCACTGCATCGCTCGCAAGAGCAAGATCATGGGATTCGGCCACC GTGTATATAAGGTGAAGGATCCGCGCGCTACGATTTTACAGAATTTAGCGGAGCAATTATTTGAGAAATTCG GCCACGATCCATACTATGATATTGCCGTCGAGCTTGAGAAAGTGGTTGCGGAGCGCTTGGGTCACAAAGGG ATCTATCCTAATGTAGACTTTTATAGTGGTTTGGTTTATCGTAAACTTGGTATTCCGACTGATCTGTTTACTCC CATCTTTGCTATTGCACGCGTGGCGGGATGGTTGGCTCACTGGAAGGAACAGTTAAGTGAGAATCGTATCTT TCGCCCGACGCAAATCTATACTGGATCTCACAACATGCCTTACATCCCCATCGAAGAGCGTGATTTGGCGAT CGAATCTGAT
ancC	ATGGCGGTCTCTGAGTACAAGCCGGGTTTAGAGGGTGTACCTGCGACGCAGTCATCTATCTCGTTTGTCGA TGGCCAACGTGGTATCCTGGAATACCGCGGCATTAGCATCGAAGAGCTGGCAAAACACTCGACATTTCTGG AAACTGCTTACTTACTGATTTGGGGTAAATTACCCACACAAGAAGAACTGGCGGAGTTTGAGCATGAGATCC GCTACCATCGTCGCATCAAGTATCGTATCCGCGACATGATGAAGTGTTTCCCCGAGTCTGGTCATCCAATGG ATGCATTACAGGCTTGCGCCGCGGCTCTGGGTTTATTCTATTCGCGTCGTGCTCTGGACGATCCTGAGTACA

	TTCGCGCGGCTGTTGTGCGTCTTTTAGCTAAGATTCCGACTATGGTTGCAGCCTTCCAACTGATGCGCAAAG GAAACGACCCTGTTCAACCTCGTGACGACTTGGACTATGCAGCAAATTTTTTGTATATGCTTAATGAGCGCG AGCCAGATCCCTTGGCGGCACGCATTTTCGATGTTTGCTTAACGTTACACGCTGAGCATACAATCAACGCTT CTACGTTTAGTGCGATGGTCACAGCCTCAACATTGACTGATCCTTACGCCGTCGTCGCCTCAGCGGTTGGC ACCCTTGCGGGCCCGTTACATGGGGGCGCCAACGAAGAAGTACTTACTATGCTGGAAGAGATCGGGTCTGT GGAAAATGTGCGCCCCTATTTGGAGCACTGCATTGCCCGCAAGGCAAAGATCATGGGTTTTGGTCATCGTG TTTACAAAGTGAAAGACCCTCGTGCCACCATCTTGCAGAACCTGGCTGAACAATTATTTGAGAAGTTCGGCC ACGACCAGTACTACGATATTGCATTAGAACTTGAGCGTGTGGTTGCAGAACGTCTGGGTCACAAAGGTATCT ACCCGAACGTCGATTTCTACTCTGGCCTGGTTTACCGTAAACTTGGCATCCCTACCGATTTGTTTACCCCCG TTTTCGCTATTGCACGCGTCGCAGGCTGGCTGGCACACTGGAAGGAACAGCTGTCTGAGAATCGTATTTTC CGTCCGACACAGATCTATACAGGTTCCCATAACATGCCGTATGTGCCCATTGAGGAACGT
ancC q18L	ATGGCGGTCTCTGAGTACAAGCCGGGTTTAGAGGGTGTACCTGCGACGCTGTCATCTATCTCGTTTGTCGA TGGCCAACGTGGTATCCTGGAATACCGCGGCATTAGCATCGAAGAGCTGGCAAAACACTCGACATTTCTGG AAACTGCTTACTTACTGATTTGGGGTAAATTACCCACACAAGAAGAACTGGCGGAGTTTGAGCATGAGATCC GCTACCATCGTCGCATCAAGTATCGTATCCGCGACATGATGAAGTGTTTCCCCGAGTCTGGTCATCCAATGG ATGCATTACAGGCTTGCGCCGCGGCTCTGGGTTTATTCTATTCGCGTCGTGCTCTGGACGATCCTGAGTACA TTCGCGCGGCTGTTGTGCGTCTTTTAGCTAAGATTCCGACTATGGTTGCAGCCTTCCAACTGATGCGCAAAG GAAACGACCCTGTTCAACCTCGTGACGACTTGGACTATGCAGCAAATTTTTTGTATATGCTTAATGAGCGCG AGCCAGATCCCTTGGCGGCACGCATTTTCGATGTTTGCTTAACGTTACACGCTGAGCATACAATCAACGCTT CTACGTTTAGTGCGATGGTCACAGCCTCAACATTGACTGATCCTTACGCCGTCGTCGCCTCAGCGGTTGGC ACCCTTGCGGGCCCGTTACATGGGGGCGCCAACGAAGAAGTACTTACTATGCTGGAAGAGATCGGGTCTGT GGAAAATGTGCGCCCCTATTTGGAGCACTGCATTGCCCGCAAGGCAAAGATCATGGGTTTTGGTCATCGTG TTTACAAAGTGAAAGACCCTCGTGCCACCATCTTGCAGAACCTGGCTGAACAATTATTTGAGAAGTTCGGCC ACGACCAGTACTACGATATTGCATTAGAACTTGAGCGTGTGGTTGCAGAACGTCTGGGTCACAAAGGTATCT ACCCGAACGTCGATTTCTACTCTGGCCTGGTTTACCGTAAACTTGGCATCCCTACCGATTTGTTTACCCCCG TTTTCGCTATTGCACGCGTCGCAGGCTGGCTGGCACACTGGAAGGAACAGCTGTCTGAGAATCGTATTTTC CGTCCGACACAGATCTATACAGGTTCCCATAACATGCCGTATGTGCCCATTGAGGAACGT
AltaII ancC	ATGACAGTGTGTGAATATAAGCCCGGACTGGAGGGGGTGCCTGCAACTCAATCATCAATCAGTTACGTTGA CGGTCAGAAGGGCATCTTGGAGTACCGTGGTATTCAGATTGAGGAATTGGCACAGCATTCCACCTTTTTGGA AACAGCATACCTGTTAATCTGGGGAACTTTACCGACGCAGGAGGAGCTTACGGACTTTGAGCATGAAATCC GCTATCACCGCCGTATCAAATACCGCATTCGTGATATGATGAAGTGCTTTCCAGAATCTGGACATCCCATGG ACGCGCTGCAGACGTGCGCTGCTGCCCTTGGTCTTTTCTACTCGCGTCGCGCTCTGGACGACCCAGAGTAC ATCCGCGCGGCTGTCGTCCGCTTGTTAGCTAAAATCCCAACAATGGTGGCCGCGTTCCAGTTGATGCGTAA AGGTAATGACCCAGTTCAACCTCGCGATGATTTGGACTATGCGGCGAATTTCCTTTATATGTTAAATGAACGC GAGCCCGATCCACTTGCGGCGCGTATCTTCGACGTGTGTTTAACCTTACATGCTGAACATACGATTAACGCC AGCACATTTTCTGCCATGGTAACAGCCTCGACATTGACGGACCCTTATGCGGTCGTGGCCTCAGCTGTAGG AACTCTTGCCGGTCCTCTTCACGGTGGGGCTAATGAGGAGGTTATCACTATGTTGGAGGAGATTGGATCCG TCGAGAACGTGCGTCCGTACCTGGATAATTGTCTGGCCCGTAAAGCAAAGATTATGGGATTCGGCCACCGC GTCTACAAGGTCAAGGATCCTCGCGCGACCATCCTTCAGAATCTGGCCGAACAATTATTTGAGAAATTTGGC CATGATCCGTATTACGACATTGCCATCGAGTTGGAGAAAGTGGTTTCCGAGCGTCTTGGTCACAAGGGTATC TATCCGAATGTCGACTTCTACTCGGGGTTGGTGTACCGCAAACTGGGCATCCCAAGCGACCTGTTTACACC CATCTTCGCCATTGCACGTGTTGCTGGGTGGCTTGCTCATTGGAAGGAACAGTTATCCGAGAACCGTATCTT TCGCCCCACACAGATCTACACAGGGAGCCACAATATGCCGTATATCCCCATTGAAGAGCGTGATTTGGCGA TCGAATCTGAT
ancD	ATGGCGGTTGGCGAGTATAAACCGGGCCTGGAAGGTGTACCAGCGACGCAATCTAATATTAGTTTCGTCGA TGGGCAACGTGGTATCTTGGAATATCGTGGTATTCCTATTGAGGAATTAGCAAAGCACAGTACTTTTTTAGAA ACTGCCTATCTTCTGATCTTCGGTAAACTTCCGACACAGGATGAATTAAAGGAGTTCGAGCATGAGATTCGT CACCATCGCCGTATCAAATACCGTATTCGCGACATGATTAAGTGCTTCCCTGAGTCCGGCCACCCTATGGAC GCCCTGCAAACATGTGTCGCTGCTCTTGGACTGTTCTACCCGTTACGCGAATTAGATGATCCTGACTATATT CATGGGGCCACGGTACGCCTGCTGGCAAAGATCCCCACCATGGTGGCTGCATTCCACATGATGCGTCAGG GCAATGACCCCGTTCAGCCCCGCGACGACCTTGATTACGCGGCAAATTTCTTGTATATGTTGAATGAGAAAG AACCGGATCCATTAGCCGCACGTATCTTCGATGTCTGCTTAATCCTTCACGCAGAACACACGGTCAATGCTT CTACCTTCTCCGCCTTGGTTACTGCTAGTACTTTAACAGATCCATATACGGTTATCGCTTCCGCTGTCGGCAC CCTGTCGGGGCCTCTTCACGGAGGAGCAAATGAACAGGTAATGACCATGTTAGAGGAGATCGGTAGCGTC GAAAATGTCCGTCCGTACCTTGAGCGCAAGCTTGCGCGTAAGGAAAAAATCATGGGATTTGGACATCGTGTT TATAAAGTCAAAGATCCGCGCGCAACCATCCTTCAAAACCTTGCCGAGGAGCTTTTTGACAAATTCGGACAC GATCCCTACTATGACATCGCGCTTGAGCTGGAGCGTGTGGCCGCTGAACGCCTGGGCCACAAGGGTATCTA CCCTAATGTTGACTTTTACTCAGGCCTTGTATATAAAAAACTGGGCATTCCAACCGACCTGTTTACTCCAGTT TTCGCTATTGCTCGTGTCGCGGGGTGGCTGGCACACTGGAAAGAGCAATTGAGTGACAACCGCATCTTTCG CCCCACCCAGGTCTACACTGGAGAGCATAACGTACCTTACGTTCCTATTGCAGAACGCGATTTGGCGATCG AATCTGAT
ancE	ATGGCAGACGGCGAATATAAACCCGGCTTAGAGGGTGTACCGGCCACTCGTAGCAATATCAGCTTCGTAGA TGGTCAAGCAGGGATCCTTGAATATCGTGGTATTCCAATTGAGGAACTTGCTGAACATAGTACGTTCTTGGA GACGGCTTACTTACTGATTTTCGGCAAGTTACCCACACAGGATGAGTTAGATGAGTTCGAGCACGAGATTCG TAGCCACCGTCGTGTCAAATACCGCATCCGTGATATGATTAAGTGTTTTCCAGAATCCGGCCATCCGATGGA CGCGTTGCAAACATGCGTGGCTGCATTGGGCCTGTTTTACCCATTACGTGAGATGGACGATGACGACTATG TGCACGGCGCTACAGTACGCTTGCTTGCCAAAATCCCCACTATGGTGGCAATGTTCCATCAAATGCGCCAA GGGAATGATCCTATCCCGCCCCGTGATGATTTGGATCATGCGGCTAATTTTTTGTATATGTTAACAGGAAAA GAACCTGATCCTCTGGCAGCCCGCATTTTTGATGTTTGTTTGATCTTGCATGCCGAGCACACAGTGAATGCC AGCACATTCTCGGCCTTGGTTACAGCTTCCACCTTAGCTGACCCCTACACAGTGATCGCTAGCGCCGTTGG AACACTTTCAGGCCCTCTGCATGGTGGTGCTAACGAACAAGTGATGCAAATGTTAAAAGAGATCGGTTCTGT AGAGAACGTCCGTCCGTATATTGAGGAGAAATTGGCCCGCAAAGAGAAGATCATGGGGATGGGCCACCGT GTATATAAAGTGAAGGACCCACGCGCCACCATCTTACAGAACTTAGCGGAAGAGTTGTTCGACCGTTTCGG ACATGACCCATATTATGACATCGCTCTGGAAGTAGAGCGCGTGTGTGAGGAGCTGCTGGGTCACAAAGGCA TCTATCCTAATGTTGACTTCTACTCGGGTTTAGTCTATTCAAAACTTGGGATTCCCACGGACTTATTTACCCCT GTATTCGCAATCGCCCGCGTGGCCGGATGGTTGGCACACTGGCGCGAACAATTGTCAGACAACCGTATTTT TCGCCCTACCCAAGTATATACCGGGGAACGCAATGTCCCGTATACACCGTTATCAGAACGCGATTTGGCGAT CGAATCTGAT

CS *Methylophaga sulfodovorans* NCBI Reference Sequence: WP_091715369.1	ATGAGCGACTTTCTTCCTGGGCTTGAAGGGGTTCCAGCTACCAAAAGCGCAATTTCTTTCATTGACGGGGAG AAAGGCATTCTTAGCTATCGCGGTTATCCTCTGGAGACGCTTGCTGAAAATAGCACTTTCGAGGAAACGACG CTTCTGCTTTTAGATGGCGAGTTGCCGACGAAGAAGGCGCTTAATGACTTTAGCCAGCAACTGAAGGACAAT TATCGCATCAAGTATCACATTCGCCAAATGATGCGTCATTTTCCTCATACAGGACATCCGATGGATATGCTTC AGACAGCCGTTTCCTCTTTAGGCATGTTTTATCCCGGCACTGAATGCCTGACTGACGCCAACTCCTGCGAAG ACCTGGACTATGTTCGCAATATGACAGTGAATATTATTGCACAGATGGCCCCATTAGTGGCGATGTGGGAAC ATATCCGTAATGGATGGGACCCTGTTAACCCAAAGCATGACCTTAGCGTCGCCGAGAACCTGCTTTACATGT TCAATGGGGAAGAGCCGGATCCTCTGATGGCGAAAATCATGGATGTGTGCCTGATCCTGCATGCCGAGCAT ACACTGAATGCTTCTACCTTTGCCGCGTTAGTAGCTGGGTCAACACTGGCGACCCCATACTCCGTTATCAGT GCGGCAATCGGGACATTGTCGGGTCCATTGCATGGTGGAGCGAATCAGCGTGTCGTTGGCATGCTGCAGG AGATTGGGAGCCCGAAGAACGTCGAAAGTTGGGTAGACGAAAAATTAAAAAACAAGGAAGTTATTTGGGGA ATGGGTCACCGCGAATATAAGGTCAAGGACCCGCGCGCGACTATTTTGCATAAACTGGTAGAGCAGTTGGT AGCCGAACGTGGGGGTCACCTTGACGATATGTTTGACACAGCCTTAAAACTTGAGGAGGTTTGCGCTGATC GTCTTGGGCACAAAGGCGTTTATCCTAATGTAGACTTTTATTCTGGCATCTTGTATTCGGAAATGGGTATCCC CGAGGACGAGTTTACGGCCTTGTTCGCTGTGGCTCGCAGCGCAGGATGGCTGGCTCATTGGCGTGAACAG ATTTCAGATAATCGTATCTATCGTCCTACCCAAATCTATGTCGGCTCCGATATGCGCGATTACACACCAATCG AAGAGCGC
CS *Gloeobacter violaceus* NCBI Reference Sequence: WP_011143005.1	ATGTCAGGGGAGTATGTGCCTGGATTAGAAGGCGTACCAGCAACACGTTCAAATATCTCGTTTGTGGACGG AAAAGCAGGTGTGTTAGAGTATCGCGGTATTCCGATCGATCAGTTGGCCGAGTCATCTACATTTTTAGAAAC AGCTTTTTTGCTGATTTTCGATCATTTGCCTACGAAGGACGAATTATTGAGCTTCGAAGTTGAGATTTTAGGC CATCGTCGTGTAAAATATCGCATTCGCGACATGATCAAAAGCTTCCCCGAGAGTGGCCGTCCCATGGTCGC CCTTCAGTCTTGCATCGCGGCGCTTGGCTTATTTTACCCCTTGCAGAACGAATCGAAAGAAAAATACGCCTA CGATAGTACTATCCGTTTATTAGCTAAAATGCCCACCATGGTAGCCACCTTTCATCAAATGCGCCTGGGGAA CGATCCCATCCCACCACGCGATGATTTGGGGCATGCCGCAAACTTCTTGTATATGTTGACGGGAAAAGAAC CGGACCCGCGTGCAGCTCGTATCTTTGACGTTTGCCTGATGTTGCATGCAGAACACACGGTCAATGCTTCTA CCTTCAGCGCCCTTGTTACGGCATCAACTTTGGCAGACCCATACACTGTAATCACCAGTGCGGCAGGAACAT TGTCCGGCCCTCTGCACGGAGGTGCGAACGAGGAAGTCATTCGCATGTTAAAGGAAATCGGCACCATCGAA CGTGTACGCCCATACTTAGAAAATCGTTTAGCTCGTAAAGAAAAGATCATGGGCGTCGGCCACCGCGTATAT AAGGTGAAAGACCCACGCGCAACGATTCTTCAAAACTTAGCTCAAGAGCTTTTTGATCGCTTCGGCCACAGC CGTTTATACGACATTGCCGTGGAAGTGGAGCGCGTTTGCGACGAGCTTTTGGGTCAAAAAGGAATCTATCC GAATGTAGATTTCTATTCAGGGTTGGTCTATGAGAAAATGGGGATTCCGGCTGATATGTTTACACCGGTCTTT GCGATTTCCCGCGTCGCCGGATGGCTGGCACATTGGCATGAACAGTTGGCGGACAATCGTATTTTCCGCCC AACGCAAGTTTATACTGGCAGCCATAACGTGGAGTTCACGCCCCTTTCGTTGCGCAGCTACGCA
CS *Pseudanabaena biceps* NCBI Reference Sequence: WP_175355653.1	ATGGCCATCGGCGAGTATAAACCAGGATTAGAAGGCGTGCCCGCGACCCAGAGCAACATTTCATACGTCGA CGGAAAAGCGGGGCTTCTGGAGTATCGTGGGATCCGTATCGAAGAATTGTGCGTACACAGTAGTTTCTTGG AGACATCATATCTGTTAATCTTTGGTGAGTTACCTACGTCGGCGAAGTTAAAGGAGTTTGAAGTTGATATTAC CCACCGTCGTCGCATCAAATATCGTATCCGTGATATGATTAAATCGTTTCCTGATAACGCACACCCCATGGAT GCCTTGCAAACCAGTGTGGCGGCACTGGGCATGTTTTATCCGTTGGGAGATTTCCACGACGCGGATTATAT CTATCAGGCGACCGTGCGTCTGCTTGCCAAAGTGCCCACTATGGTTGCAGCCTTCCATATGATGCGTCAAG GCAATGATCCAGTTATGCCACGCGACGATCTGGACTATGCGTCGAACTTCCTTTACATGCTGAATGAGAAAG TGCCGGACCCTTTAGCCGCGCGTATCTTTGACGTTTGTCTGACTTTACACGCGGAACACACTGTTAATGCAA GCACGTTTGCGGCGTTGGTCACGGCTTCAACGTTAACGGATCCCTACGCGGTTATTACATCGGCTATCGGA ACGTTAGCCGGCCCACTGCACGGGGGCGCCAACGAACAAGTGATGATGATGTTGGAGGAAATCGGTTCCG TTGATAATGTTACCGCGTATTTAGAACGTAAGATCGAGCGCAAGGAGAAGCTTATGGGCTTTGGCCACCGTA TTTACAAAGTAAAGGATCCGCGTGCTATTGTATTGCAAGAGTTAGTCCATAAAATGTTTGACCAGTTCGGACA TGACCATTACTACGATATCGCCTTGGAGTTAGAGAAACAGGCATTTGAGAAACTTTCGTCAAAGGGAATCCA CCCGAACGTAGATTTTTACTCTGGGTTAGTCTACAAGAAGCTTGGAATCCCTAGCAACTTATTCACGACAATC TTCGCTATCGCCCGTGTGCCAGGTTGGCTTGCTCATTGGAAAGAACAATTGAGTGACAATCGTTTATTCCGC CCGACTCAGGTCTACACGGGGCTTCATGATGTTACGTATTTACCTATTGAACATCGT
CS *Cyanothece sp. SIO1E1* GenBank: NET35916.1	ATGACATTCTGTGAATATAAACCCGGGCT?GAAGGAATTCCGGCGACCCAAAGTTCAGTAAGTTATGTTGAT GGTCAGCGTGGAATCCTGGAGTATCGCGGCATCCAAATCGAAGCACTTGCCGCTAAGTCAAATTTCCTTGA GACAGCCTACCTTTTGATCTGGGGTGGTTTACCTACTCATGAGGAGTTGGCGTCATTTGAATCGGAAATTCG CTACCACCGTCGTTTGAAGTACCGTATCCGCGACATGATGAAGTGCTTTCCGGAAAGCGGTCACCCGATGG ATAGCCTGCAGGCGTGTGCAGCCGCCCTGGGTCTGTTCTATTCGCGTCGCGCACTTGATAACCCTGTTTAT ATTCGCGCTGCGGTAGTTCGTCTGCTTGCCAAAATCCCTACTATGGTAGCTGCTTTTCAGATGATGCGCAAA GGAAATGACCCCATCCAACCGCGCGACGATCTGAGCTACTCTGCCAACTTTCTGTATATGCTTAATGAACGT GAACCGGATCCGTTAGCTGCTCACATCTTCGATGTGTGTCTTACGCTTCATGCCGAGCATACTATCAACGCG TCAACCTTTTCCGCAATGGTGACCGCCAGTACACTTACAGATCCCTACGCGGTTGTCGCGTCAGCCGTGGG TACATTAGCAGGACCCCTTCATGGAGGCGCGAATGAAGAGGTGCTTTCTATGCTGGAGGAAATTGGAAGCG TGGGTAATGTGCGCCCGTACTTGGAAGATTGTCTGCAGCGCAAAGCGCGCATTATGGGATTCGGTCACCGC GTGTACAAGGTCAAAGATCCACGCGCCATTATTCTGCAAGACCTGGCAGAACAGTTGTTTGAAAAGCTTGGT GGCGATCGTTACTACGACATTGCAGTAGAGCTTGAGCGCCAGGTCTCTGAAAAATTGGGGCACAAAGGCAT CTATCCAAACGTCGACTTTTATTCGGGATTGGTCTATCGTAAGTTGGGTATTCCCCGCGATATGTTCACGCC GGTCTTCGCTATTGCCCGTGTTGCTGGGTGGTTGGCGCATTGGAAGGAGCAACTTGCTGAGAACCGCATCT TTCGTCCGACTCAGATCTACACTGGACCTCGCCACATTCCTTATGTAGCTATTGCTGATCGTCATCCACCCC AGGAGGAGGTCATTCTTACTAATTTACTTGCAGAT
CS *Planktothrix mougeotii* NCBI Reference Sequence: WP_193869840.1	ATGACAGCCGTCTCCGAATTCAAACCTGGCCTTGAGGGGGTACCAGCTACACTGTCGTCAATTTCATACGTG GATGGGCAAAAGGGTATCCTTGAATATCGTGGCATCTCCATCCAACAGTTGGCTAATTACTCAACCTTTTTG GAGACGAGTTATTTATTAATCTGGGGCAAATTACCGACTAAAGACGAACTGGAAGCATTTGAGCATGAAATT CGCTATCACCGTCGCATTAAGTATCGTATTCGTGATATGATGAAATGTTTTCCGGAAACTGGACACCCTATG GATGCATTACAGACGTCCGCTGCAGCCTTGGGCCTGTTTTATAGTCGCCGCGCTTTAGACAACCCCCAGTA CATTCGTGAAGCAGTCGTTCGTTTGTTGGCAAAAATCCCAACTATGGTCGCGGCCTTCCAATTAATGCGCAA AGGAAACGATCCAGTGCAACCGCGCGATGACCTTGATTACTCAGCTAATTTCTTATATATGTTGTCTGAGCG TGAGCCAGACCCCCTTGCCGCGTGGGTTTTCGACGTTTGCCTTACGCTTCACGCGGAACACACAATCAATG CAAGTACATTCAGCGCAATGGTCACAGCTAGTACTTTGACGGATCCTTATGCAGTCATTGCTTCAGCAGTAG GCACATTAGCCGGTCCGTTGCACGGTGGGGCTAACGAGGAGGTGTTAGTAATGCTGGAGGAAATTGGGGC AGTTGAGAACGTTGGTCCTTATGTGGATAACTTGATTGCCAAGAAAAGTAAAATCATGGGATTTGGCCATCG CGTTTATAAAGTTAAAGACCCTCGTGCTACAATTTTGCAACAGTTAGCTGAGAAGCTGTTCGAGAAGTTTGG GCATGACCAGTACTATGAAATTGCCTTGGAACTTGAAAAAGTCGTAGCGGACCGTTTAGGTGGGAAGGGGA TCTATCCGAATGTCGACTTCTATAGTGGCCTGGTGTACCGCAAGTTGGGAATCCCCGCTGACTTATTTACTC CGATCTTCGCTATCGCCCGTGTGAGTGGGTGGCTGGCTCATTGGAAAGAGCAATTAACAAAAAATCGCATCT

	TTCGCCCAACTCAAATCTATACGGGCAGTCACAATGAGACTTATGTGCCTATCCATGAGCGTAATTGTGCAA TTAACCTTGAAGAATCAACGTTG
Δ2-6 CS Planktothrix mougeotii	ATGTTCAAACCTGGCCTTGAGGGGGTACCAGCTACACTGTCGTCAATTTCATACGTGGATGGGCAAAAGGG TATCCTTGAATATCGTGGCATCTCCATCCAACAGTTGGCTAATTACTCAACCTTTTTGGAGACGAGTTATTTAT TAATCTGGGGCAAATTACCGACTAAAGACGAACTGGAAGCATTTGAGCATGAAATTCGCTATCACCGTCGCA TTAAGTATCGTATTCGTGATATGATGAAATGTTTTCCGGAAACTGGACACCCTATGGATGCATTACAGACGTC CGCTGCAGCCTTGGGCCTGTTTTATAGTCGCCGCGCTTTAGACAACCCCCAGTACATTCGTGAAGCAGTCG TTCGTTTGTTGGCAAAAATCCCAACTATGGTCGCGGCCTTCCAATTAATGCGCAAAGGAAACGATCCAGTGC AACCGCGCGATGACCTTGATTACTCAGCTAATTTCTTATATATGTTGTCTGAGCGTGAGCCAGACCCCCTTG CCGCGTGGGTTTTCGACGTTTGCCTTACGCTTCACGCGGAACACACAATCAATGCAAGTACATTCAGCGCAA TGGTCACAGCTAGTACTTTGACGGATCCTTATGCAGTCATTGCTTCAGCAGTAGGCACATTAGCCGGTCCGT TGCACGGTGGGGCTAACGAGGAGGTGTTAGTAATGCTGGAGGAAATTGGGGCAGTTGAGAACGTTGGTCC TTATGTGGATAACTTGATTGCCAAGAAAAGTAAAATCATGGGATTTGGCCATCGCGTTTATAAAGTTAAAGAC CCTCGTGCTACAATTTTGCAACAGTTAGCTGAGAAGCTGTTCGAGAAGTTTGGGCATGACCAGTACTATGAA ATTGCCTTGGAACTTGAAAAAGTCGTAGCGGACCGTTTAGGTGGGAAGGGGATCTATCCGAATGTCGACTT CTATAGTGGCCTGGTGTACCGCAAGTTGGGAATCCCCGCTGACTTATTTACTCCGATCTTCGCTATCGCCCG TGTGAGTGGGTGGCTGGCTCATTGGAAAGAGCAATTAACAAAAAATCGCATCTTTCGCCCAACTCAAATCTA TACGGGCAGTCACAATGAGACTTATGTGCCTATCCATGAGCGTAATTGTGCAATTAACCTTGAAGAATCAAC GTTG
CS *Cyanobium sp. PCC7001* NCBI Reference Sequence: WP_006910478.1	ATGGCCGGGAGCTTGAGTGATAGTGTACCTGGATCGACTGGAGGGGCAACGGCTGCCCCACCATTTCGTC CCGGGTTGGAAGGTGTACCAGCAACTCAGAGCGCGATCTGTGACATTGATGGACAAAAGGGTCGTTTAACA TACCGCGGGTACGACGCGGGGGAGCTGGCCGCTCATAGCACGTTCTTGGAAACAACCTACTTATTAATTTG GGGAGAGCTTCCCACCGCCGAAGGTTTGCGTCAGTTTGAACACGAGGTTCAGATGCATCGCCGTGTTTCCT TCCGTATTCGTGACATGATGAAATGCTTCCCCGCTACAGGCCATCCCATGGATGCATTGCAGTCGTCCGCC GCCAGCTTGGGTCTGTTTTATTCCCGCCGTGCGCTGGACAATCCCGAGTATATTGCAGAAGCGGTGGTACG CTTAATTGCCAAAATTCCCACTATGGTAGCAGCCTTCCAACTGATTCGCAAGGGCCAGGATCCGATCCAACC GCGCGACGATCTTCCATTCGCGTCGAACTTTCTTTACATGCTGACTGAGCAGGAACCTGATCCTCTGGCGG CTCGCATCTTCGATGCATGTCTGATCTTACATGCTGAGCATTCTCTGAACGCAAGCACGTTCTCGGCGCGCG TCACTGCTTCTACTTTGACTGACCCCTACGCCGTCGTGGCGAGCGCAGTTGGCACGTTGGCTGGCCCACTG CACGGTGGCGCAAACGAGGATGTCCTGGCCATGTTGGAGGCTATCGGGAGTGCAGACCAGGTGGAACCGT GGTTGGACCGTGCAATCGCCCAGAAACAAAAGATTATGGGTTTTGGTCATCGCGAGTACAAGGTGAAAGAC CCTCGCGCCGTGATTTTACAGGGCTTAGCGGAACAGCTTTTCCACCGTTTCGGGCACGACCCCTTGTATGA CTTAGCGCGTAAACTGGAAGAAGCTGCGGCAGAACGCTTAGGCCCGAAAGGTATCTACCCGAACGTAGATT TTTATTCCGGCTTGGTCTACCGTAAGTTAGGGATCCCGCGCGATCTTTTTACACCTATTTTTGCCATCGCCCG CACAGCAGGTTGGCTTGCGCACTGGAAGGAGCAATTAGGTGCAAACCGCATCTTCCGTCCATCACAGATCT ACACAGGACCTGTACCCCGCGACTGGGTCCCCCTTGAAGCCCGT

Supplementary table 3 List of homology cassettes used for transformation of *S.elongatus* PCC7942

CS variant	DNA sequence full homology cassette
Wildtype SeCS	GGCAGCAAACGCCGCAATCTCCAGATTCAAGCCACAGTACGGGGTGGCCATGGTCGCGATGGTGATTTTGAAGT GTTTGCCACCTCCCTCGATCGCCTTGCGACAGCACTCGAAGGCCGCGATTCCCTGACGACAAATCCTGACTTCC GCCAAGCCCAGCGCCAACTACCCCAACCCAATCAAGGTGTCCTCTACCTTGACTGGCAGGCCAGTGCCCTACC GCTGACGCAACGCTGGCCTGTCTTGCAGCTGATTGCCCTGCCCTTGCAACCCCTGTTGGAGCACGTGCAGGCG ATCGCGATCGCCAGTCCTACCCCTCCCGAAGACAGCACTGACCTGCAGCGACTCTCAATCGAACTGCTGTTGCG GAGCTAGGCGATGGAACTCTATCTGATCCGCCATGGCATCGCCGCCGAACGGGGCACCTACGCGGATGATGAC CGGCGCCCCCTGACAGCCACGGGAGAACGCCGCAGTCAACGAGTTGCCCAGCGACTGCTGTCTCTCGGTCTGC ATTTCGATGTTCTGCAAACCAGTCCCCTAGTCCGCGCCCACCAAACCGCCGTCATCCTTCAACAAGAGGGGCTG GCTTCCCAAATCGCGATCGCCCCAGAATTAGCGCCCGAAGGCAGTCTGACCGCTTGGCTCCGGCGCTTACCGC CCGCCATCTCGGCTGATCAGCGCTGGGCGATCGTGGGCCATGAACCCGATCTAGGGGTCTGGGCGGAACAGCT GGTCTGGGGATCTGCCCAGGACAAGCTCGTTCTCAAGAAAGCCGGTCTGATCGGTCTGCAATTCCCAGGCGATC GCCCTGCGATCGGAGCCGGATCCCTCTTCTGGCTAACCCCCCGCGCCTTCTCCTTTAGGGGCACCTGATCAAA TTGGCGAAAGACGCGCGGCAGACCCACCATCAGGTTTCGTGCCTGTTGCGACGAAGATGCACCAGCCAGACTG ATAGGGTATTCGGAAGAAAGACTGCATGGGGAAGCCCAGGATTGCTATGACTGCCGTCAGCGAGTTTCGGCCTG GCCTAGAAGGCGTGCCCGCCACACTCTCGAGCATTAGCTTTGTCGATGGCCAGCGCGGCGTCCTAGAGTATCG CGGCATCAGCATCGAGCAACTGGCGCAACAGAGCAGTTTTCTGGAAACCGCCTACCTGTTGATTTGGGGCCATC TACCAACTCAGCAGGAATTGACCGAGTTCGAGCACGAAATTCGCTACCACCGCCGCATCAAGTTCCGCATCCGG GACATGATGAAATGCTTCCCCGATAGCGGCCATCCTATGGATGCCCTGCAGGCGAGCGCCGCAGCCCTCGGGT TGTTCTATTCGCGGCGCGCCTTGGATGATCCCGAATACATTCGGGCGGCCGTTGTGCGTTTGCTAGCCAAAATT CCGACGATGGTGGCTGCCTTCCAGCTGATCCGCAAGGGTAACGACCCAATTCAGCCCCGCGATGAACTGGACT ACGCCGCCAACTTTCTCTACATGCTGACGGAGCGCGAGCCCGATCCAGTCGCAGCTCGGATTTTTGATATTTGC CTCACCCTGCACGCCGAACATACGATCAACGCCTCGACCTTCTCGGCGATGGTCACAGCTTCGACCCTGACCGA TCCCTACGCTGTCGTTGCTTCTGCCGTTGGCACCTTGGCTGGCCCCCTCCATGGCGGCGCCAATGAAGAAGTG CTGGACATGCTGGAGGCGATCGGTTCCGTCGAGAATGTTGAGCCCTACCTCGACCACTGCATTGCCACCAAAAC GCGCATTATGGGCTTTGGGCACCGTGTCTACAAAGTCAAGGATCCGCGGGCAGTCATTCTGCAAAATCTGGCCG AGCAACTGTTCGATATCTTCGGCCATGATCCCTACTACGAAATCGCGGTCGCAGTCGAAAAGGCAGCAGCCGAG CGACTCAGCCACAAGGGCATTTACCCCAACGTCGATTTCTACTCCGGCTTGGTCTATCGCAAGCTCGGTATTCCT AGCGATCTATTCACACCGGTGTTTGCGATCGCGCGGGTTGCGGGCTGGCTCGCCCACTGGAAAGAGCAGCTGA ACGAAAATCGGATCTTCCGCCCCACTCAGATCTACACGGGCAGCCACAACCTCGACTACACCCCGATCGCCGAT CGGGATTTGGCGATCGAATCTGATTGATCTAGATAATCCCTAGCGATCGCAAGTCCAAAGGTTGTCTACAATCAA TATCCAAGCATCAAAAAGCGCCCATTCGAGGCGCTTTTTGATTATTCAGACTGCTGTAATTCCGGCAATTAGGTT ATTTGCCGACTACCTTGGTGATCTCGCCTTTCACGTAGTGGACAAATTCTTCCAACTGATCTGCGCGCGAGGCCA AGCGATCTTCTTCTTGTCCAAGATAAGCCTGTCTAGCTTCAAGTATGACGGGCTGATACTGGGCCGGCAGGCGC TCCATTGCCCAGTCGGCAGCGACATCCTTCGGCGCGATTTTGCCGGTTACTGCGCTGTACCAAATGCGGGACAA CGTAAGCACTACATTTCGCTCATCGCCAGCCCAGTCGGGCGGCGAGTTCCATAGCGTTAAGGTTTCATTTAGCG CCTCAAATAGATCCTGTTCAGGAACCGGATCAAAGAGTTCCTCCGCCGCTGGACCTACCAAGGCAACGCTATGT TCTCTTGCTTTTGTCAGCAAGATAGCCAGATCAATGTCGATCGTGGCTGGCTCGAAGATACCAGCAAGAATGTCA TTGCGCTGCCATTCTCCAAATTGCAGTTCGCGCTTAGCTGGATAACGCCACGGAATGATGTCGTCGTGCACAAC AATGGTGACTTCTACAGCGCGGAGAATCTCGCTCTCTCCAGGGGAAGCCGAAGTTTCCAAAAGGTCGTTGATCA AAGCTCGCCGCGTTGTTTCATCAAGCCTTACGGTCACCGTAACCAGCAAATCAATATCACTGTGTGGCTTCAGGC CGCCATCCACTGCGGAGCCGTACAAATGTACGGCCAGCAACGTCGGTTCGAGATGGCGCTCGATGACGCCAAC TACCTCTGATAGTTGAGTCGATACTTCGGCGATCACCGCTTCCCTCATAATGTTTAACTTTGTTTTAGGGCGACTG CCCTGCTGCGTAACATCGTTGCTGCTCCATAACATCAAACATCGACCCACGGCGTAACGCGCTTGCTGCTTGGA TGCCCGAGGCATAGACTGTACCCCAAAAAAACAGTCATAACAAGCCATGAAAACCGCCACTGCGCCGTTACCAC CGCTGCGTTCGGTCAAGGTTCTGGACCAGTTGCGTGAGCGCATACGCTACTTGCATTACAGCTTACGAACCGAA CAGGCTTATGTCCACTGGGTTCGTGCCTTCATCCGTTTCCACGGTGTGCGTCACCCGGCAACCTTGGGTAGCAG CGAAGTCGAGGCATTTCTGTCCTGGCTGGCTAGGCTTAGGTCTTGGGATAGGCGATAGTAACGCCGTTGCCCCC GTCAGCTTGATCGGCAGCTTCAAACTTCGCGACAAGTGGATGCTCGCGTAGGAACTGCTGCACGCCTTGCCGCA GTTTGCCAGTGCCATGGCCATGGATGATCCAGATCGGTCCAATCGCTTGACGCAGCGCATCTTCCAGCACCACT TCGGCTTCCGAAACACGACTGCCGCGTACATCGAAGGTATTGCGATCGGTGCGAATCGCCGGCGCATCTTTGG GCGGGGGCGGCGGAGTTGTTGACTTAGGCGGGGGCGGGGGCAGTTCTACCTTTTCGCCCTGCAATGACTCCAC ATCGCCGTAGCTGACCGTCAGCTTGAGGATGCCGCAACGCACCGTTAACTCCTGACGATCCGGCGCGATCGCA AGGACTTCGCCGACCTTACCCAAGCGCGGAATCCGCAGGCGATCGCCCAACTGCGGCTGGAAACCAGGCGGT GGGGCAACGACCGTCACGGCTGGTTGTGACAGCGACTTGAGGGTTTCACTGGCCTGCCGTGCTCGTTCTGCTT TTGTCGCTTTCGGTCCCTGCTGCAGACGCCGCACCACCTTGGCAACCCGCTGTCGTGCCTGCTCAATTTCCGAC TGGATCGCCACTTCTTGCTGCTGGCGCAAGCTTTGCTCTCGCTCCCGCAATTCGGCTGTCTTGGCTTGTAGTTC GGCGTGTAGCTTTTCAGTCTGTTGCAACAACTGAGCAGCGGCGGCAGCCTTCTCTTCTTGATCGCGCCGTTGCG CTTCCAGCCCTGCGATCACGGCATCTACATCGCGATCGCGGCCCCCTTCCAGTTGCGATCGCGCCTCAGCTAC GACTGCTGGTGATAGTCCCAGTCGCTCGGCAATGATCAGCGCATTCGATCGCCCGGGGATGCCCCAGAGCAAG CGATAGGTCGGAGAGAGGGTGCGATCGTCAAATTCTACCGAGGCATTTTCGAAGCGATCGTCCTGATATTTCAG GGCCTT
L18q SeCS	GGCAGCAAACGCCGCAATCTCCAGATTCAAGCCACAGTACGGGGTGGCCATGGTCGCGATGGTGATTTTGAAGT GTTTGCCACCTCCCTCGATCGCCTTGCGACAGCACTCGAAGGCCGCGATTCCCTGACGACAAATCCTGACTTCC GCCAAGCCCAGCGCCAACTACCCCAACCCAATCAAGGTGTCCTCTACCTTGACTGGCAGGCCAGTGCCCTACC GCTGACGCAACGCTGGCCTGTCTTGCAGCTGATTGCCCTGCCCTTGCAACCCCTGTTGGAGCACGTGCAGGCG ATCGCGATCGCCAGTCCTACCCCTCCCGAAGACAGCACTGACCTGCAGCGACTCTCAATCGAACTGCTGTTGCG GAGCTAGGCGATGGAACTCTATCTGATCCGCCATGGCATCGCCGCCGAACGGGGCACCTACGCGGATGATGAC CGGCGCCCCCTGACAGCCACGGGAGAACGCCGCAGTCAACGAGTTGCCCAGCGACTGCTGTCTCTCGGTCTGC ATTTCGATGTTCTGCAAACCAGTCCCCTAGTCCGCGCCCACCAAACCGCCGTCATCCTTCAACAAGAGGGGCTG GCTTCCCAAATCGCGATCGCCCCAGAATTAGCGCCCGAAGGCAGTCTGACCGCTTGGCTCCGGCGCTTACCGC CCGCCATCTCGGCTGATCAGCGCTGGGCGATCGTGGGCCATGAACCCGATCTAGGGGTCTGGGCGGAACAGCT GGTCTGGGGATCTGCCCAGGACAAGCTCGTTCTCAAGAAAGCCGGTCTGATCGGTCTGCAATTCCCAGGCGATC

	GCCCTGCGATCGGAGCCGGATCCCTCTTCTGGCTAACCCCCCCGCGCCTTCTCCTTTAGGGGCACCTGATCAAA TTGGCGAAAGACGCGCGGCAGACCCACCATCAGGTTTCGTGCCTGTTGCGACGAAGATGCACCAGCCAGACTG ATAGGGTATTCGGAAGAAAGACTGCATGGGGAAGCCCAGGATTGCTATGACTGCCGTCAGCGAGTTTCGGCCTG GCCTAGAAGGCGTGCCCGCCACACAGTCGAGCATTAGCTTTGTCGATGGCCAGCGCGGCGTCCTAGAGTATCG CGGCATCAGCATCGAGCAACTGGCGCAACAGAGCAGTTTTCTGGAAACCGCCTACCTGTTGATTTGGGGCCATC TACCAACTCAGCAGGAATTGACCGAGTTCGAGCACGAAATTCGCTACCACCGCCGCATCAAGTTCCGCATCCGG GACATGATGAAATGCTTCCCCGATAGCGGCCATCCTATGGATGCCCTGCAGGCGAGCGCCGCAGCCCTCGGGT TGTTCTATTCGCGGCGCGCCTTGGATGATCCCGAATACATTCGGGCGGCCGTTGTGCGTTTGCTAGCCAAAATT CCGACGATGGTGGCTGCCTTCCAGCTGATCCGCAAGGGTAACGACCCAATTCAGCCCCGCGATGAACTGGACT ACGCCGCCAACTTTCTCTACATGCTGACGGAGCGCGAGCCCGATCCAGTCGCAGCTCGGATTTTTGATATTTGC CTCACCCTGCACGCCGAACATACGATCAACGCCTCGACCTTCTCGGCGATGGTCACAGCTTCGACCCTGACCGA TCCCTACGCTGTCGTTGCTTCTGCCGTTGGCACCTTGGCTGGCCCCCTCCATGGCGGCGCCAATGAAGAAGTG CTGGACATGCTGGAGGCGATCGGTTCCGTCGAGAATGTTGAGCCCTACCTCGACCACTGCATTGCCACCAAAAC GCGCATTATGGGCTTTGGGCACCGTGTCTACAAAGTCAAGGATCCGCGGGCAGTCATTCTGCAAAATCTGGCCG AGCAACTGTTCGATATCTTCGGCCATGATCCCTACTACGAAATCGCGGTCGCAGTCGAAAAGGCAGCAGCCGAG CGACTCAGCCACAAGGGCATTTACCCCAACGTCGATTTCTACTCCGGCTTGGTCTATCGCAAGCTCGGTATTCCT AGCGATCTATTCACACCGGTGTTTGCGATCGCGCGGGTTGCGGGCTGGCTCGCCCACTGGAAAGAGCAGCTGA ACGAAAATCGGATCTTCCGCCCCACTCAGATCTACACGGGCAGCCACAACCTCGACTACACCCCGATCGCCGAT CGGGATTTGGCGATCGAATCTGATTGATCTAGATAATCCCTAGCGATCGCAAGTCCAAAGGTTGTCTACAATCAA TATCCAAGCATCAAAAAGCGCCCCATTCGAGGCGCTTTTTGATTATTCAGACTGCTGTAATTCCGGCAATTAGGTT ATTTGCCGACTACCTTGGTGATCTCGCCTTTCACGTAGTGGACAAATTCTTCCAACTGATCTGCGCGCGAGGCCA AGCGATCTTCTTCTTGTCCAAGATAAGCCTGTCTAGCTTCAAGTATGACGGGCTGATACTGGGCCGGCAGGCGC TCCATTGCCCAGTCGGCAGCGACATCCTTCGGCGCGATTTTGCCGGTTACTGCGCTGTACCAAATGCGGGACAA CGTAAGCACTACATTTCGCTCATCGCCAGCCCAGTCGGGCGGCGAGTTCCATAGCGTTAAGGTTTCATTTAGCG CCTCAAATAGATCCTGTTCAGGAACCGGATCAAAGAGTTCCTCCGCCGCTGGACCTACCAAGGCAACGCTATGT TCTCTTGCTTTTGTCAGCAAGATAGCCAGATCAATGTCGATCGTGGCTGGCTCGAAGATACCAGCAAGAATGTCA TTGCGCTGCCATTCTCCAAATTGCAGTTCGCGCTTAGCTGGATAACGCCACGGAATGATGTCGTCGTGCACAAC AATGGTGACTTCTACAGCGCGGAGAATCTCGCTCTCTCCAGGGGAAGCCGAAGTTTCCAAAAGGTCGTTGATCA AAGCTCGCCGCGTTGTTTCATCAAGCCTTACGGTCACCGTAACCAGCAAATCAATATCACTGTGTGGCTTCAGGC CGCCATCCACTGCGGAGCCGTACAAATGTACGGCCAGCAACGTCGGTTCGAGATGGCGCTCGATGACGCCAAC TACCTCTGATAGTTGAGTCGATACTTCGGCGATCACCGCTTCCCTCATAATGTTTAACTTTGTTTTAGGGCGACTG CCCTGCTGCGTAACATCGTTGCTGCTCCATAACATCAAACATCGACCCACGGCGTAACGCGCTTGCTGCTTGGA TGCCCGAGGCATAGACTGTACCCCAAAAAAACAGTCATAACAAGCCATGAAAACCGCCACTGCGCCGTTACCAC CGCTGCGTTCGGTCAAGGTTCTGGACCAGTTGCGTGAGCGCATACGCTACTTGCATTACAGCTTACGAACCGAA CAGGCTTATGTCCACTGGGTTCGTGCCTTCATCCGTTTCCACGGTGTGCGTCACCCGGCAACCTTGGGTAGCAG CGAAGTCGAGGCATTTCTGTCCTGGCTGGCTAGGCTTAGGTCTTGGGATAGGCGATAGTAACGCCGTTGCCCCC GTCAGCTTGATCGGCAGCTTCAAACTTCGCGACAAGTGGATGCTCGCGTAGGAACTGCTGCACGCCTTGCCGCA GTTTGCCAGTGCCATGGCCATGGATGATCCAGATCGGTCCAATCGCTTGACGCAGCGCATCTTCCAGCACCACT TCGGCTTCCGAAACACGACTGCCGCGTACATCGAAGGTATTGCGATCGGTGCGAATCGCCGGCGCATCTTTGG GCGGGGGCGGCGGAGTTGTTGACTTAGGCGGGGGCGGGGGCAGTTCTACCTTTTCGCCCTGCAATGACTCCAC ATCGCCGTAGCTGACCGTCAGCTTGAGGATGCCGCAACGCACCGTTAACTCCTGACGATCCGGCGCGATCGCA AGGACTTCGCCGACCTTACCCAAGCGCGGAATCCGCAGGCGATCGCCCAACTGCGGCTGGAAACCAGGCGGT GGGGCAACGACCGTCACGGCTGGTTGTGACAGCGACTTGAGGGTTTCACTGGCCTGCCGTGCTCGTTCTGCTT TTGTCGCTTTCGGTCCCTGCTGCAGACGCCGCACCACCTTGGCAACCCGCTGTCGTGCCTGCTCAATTTCCGAC TGGATCGCCACTTCTTGCTGCTGGCGCAAGCTTTGCTCTCGCTCCCGCAATTCGGCTGTCTTGGCTTGTAGTTC GGCGTGTAGCTTTTCAGTCTGTTGCAACAACTGAGCAGCGGCGGCAGCCTTCTCTTCTTGATCGCGCCGTTGCG CTTCCAGCCCTGCGATCACGGCATCTACATCGCGATCGCGGCCCCCTTCCAGTTGCGATCGCGCCTCAGCTAC GACTGCTGGTGATAGTCCCAGTCGCTCGGCAATGATCAGCGCATTCGATCGCCCGGGGATGCCCCAGAGCAAG CGATAGGTCGGAGAGAGGGTGCGATCGTCAAATTCTACCGAGGCATTTTCGAAGCGATCGTCCTGATATTTCAG GGCCTT