

Report_2

February 10, 2020

1 Summary

1. Built a Gene Regulatory Network that captures the interactions between transcription factors and target genes of Cyanobacter 51142 obtained from 7 literature sources specified below.
2. The network has been updated to include the cyclicity, function, expression period and participation in a metabolic pathway of transcription factors or target genes as available in literature.
3. All the interactions are predicted by using microarray experiment data. I will include a detailed review of the algorithms used to predict the interactions in my next report as suggested by you in our previous meeting.
4. The network is sparse due to limited literature on Cyanobacter 51142.

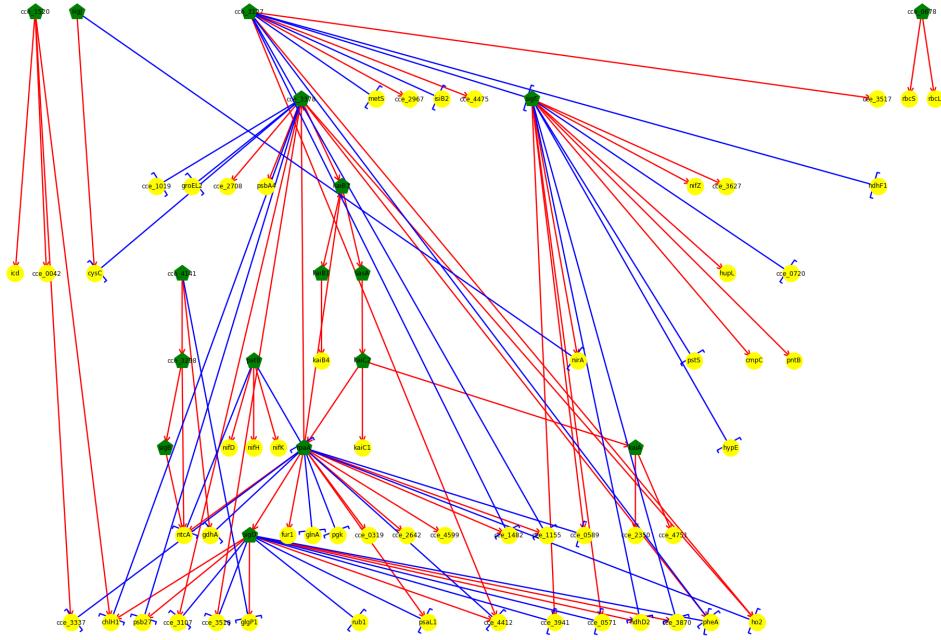
2 Gene Regulatory Network

In the networks shown below,

1. The Transcription Factors are the green pentagons.
2. The Target Genes are the yellow ellipses.
3. A red arrow denotes an activation.
4. A blue arrow denotes an inhibition.

2.1 Network1:

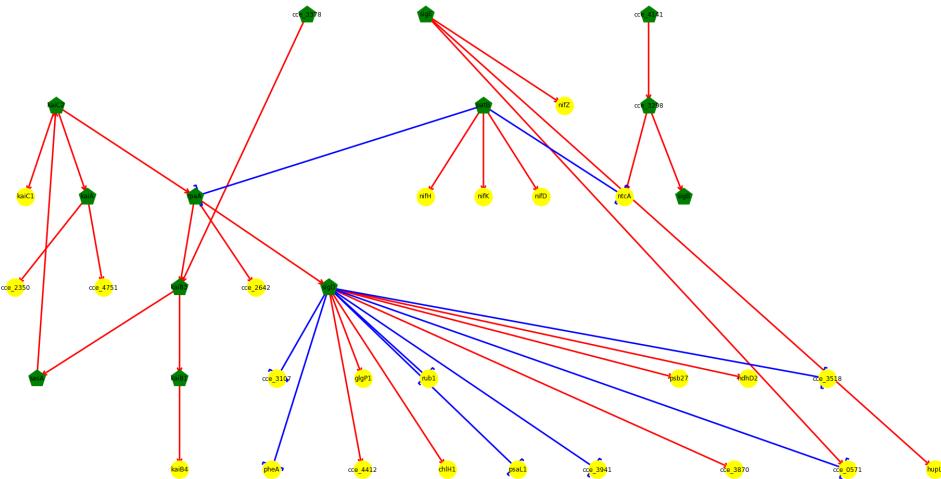
The main network is presented below:



The description of the transcriptions factors and their associated target genes of this network are in Section ??.

2.2 Subnetwork1: Circadian

Only those transcription factor and target gene that are predicted to be under *circadian rhythm* and their interactions with other transcription factors and target genes are in the network:

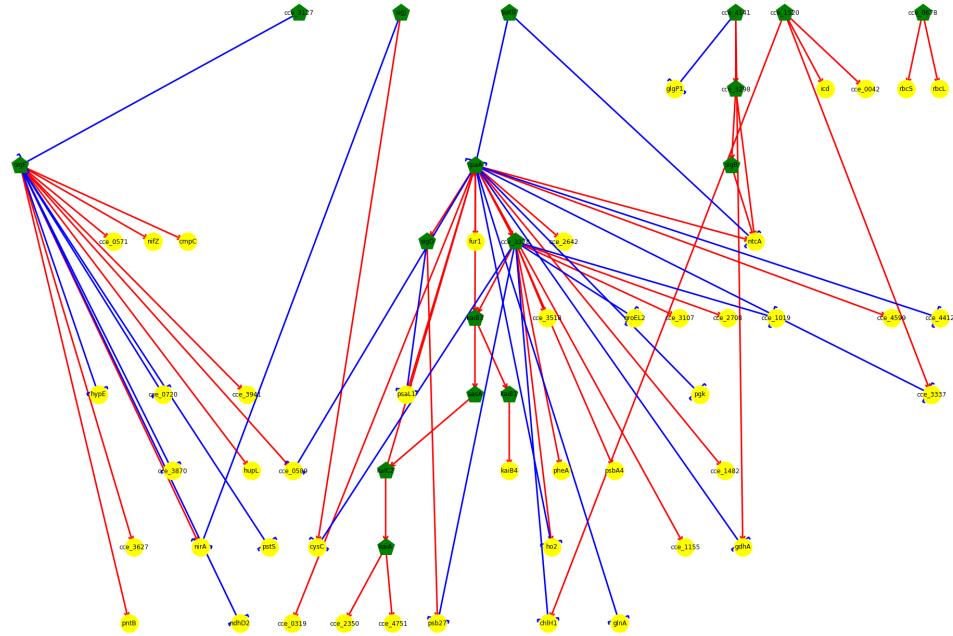


The description of the transcriptions factors and their associated target genes of this network are

in Section ??.

2.3 Subnetwork2: Diurnal

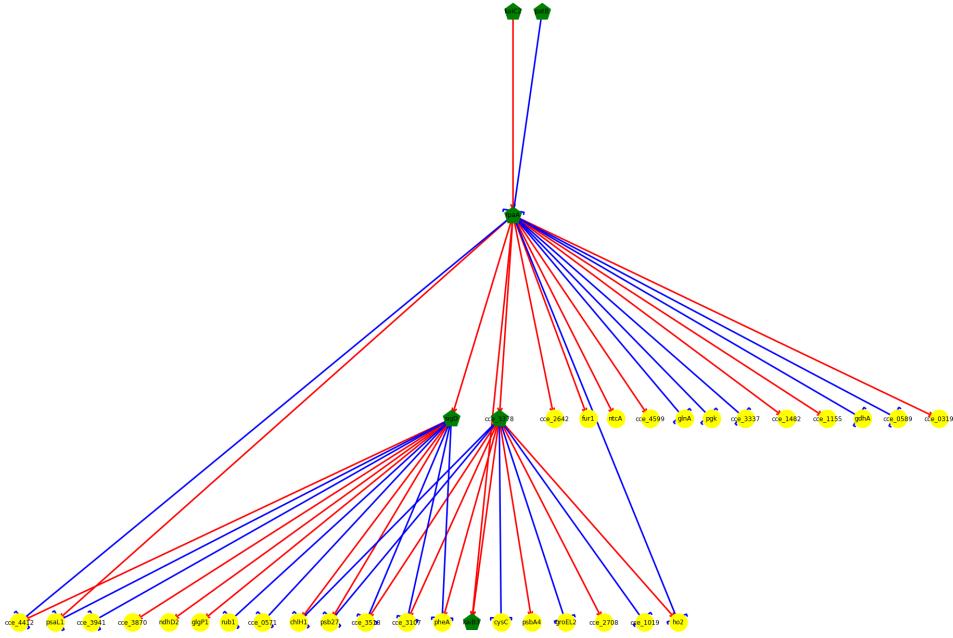
Only those transcription factor and target gene that are predicted to be under *diurnal rhythm* and their interactions with other transcription factors and target genes are in this network:



The description of the transcriptions factors and their associated target genes of this network are in Section ??.

2.4 Subnetwork 3: Light to Dark

Transcription factors and target genes that are expressed during the *light to dark* transition phase and their interactions with other transcription factors and target genes are in this network:



The description of the transcriptions factors and their associated target genes of this network are in Section ??.

3 Sources

0. The genome of *Cyanothece* 51142, a unicellular diazotrophic cyanobacterium important in the marine nitrogen cycle

Eric A. Welsh, Michelle Liberton, [...], and Himadri B. Pakrasi

1. A model of the circadian clock in the cyanobacterium *Cyanothece* sp. ATCC 51142

Nguyen Xuan Vinh, Madhu Chetty, Ross Coppel, Sandeep Gaudana & Pramod P Wangikar

2. A model of cyclic transcriptomic behavior in the cyanobacterium *Cyanothece* sp. ATCC 51142†

Jason E. McDermott,*a Christopher S. Oehmen,a Lee Ann McCue,a Eric Hill,b Daniel M. Choi,a Jana Stöckel,c Michelle Liberton,c Himadri B. Pakrasic and Louis A. Sherman

3. Metabolic Rhythms of the Cyanobacterium *Cyanothece* sp. ATCC 51142 Correlate with Modeled Dynamics of Circadian Clock

Jan Červený* and Ladislav Nedbal*,†

4. Global transcriptomic analysis of *Cyanothece* 51142 reveals robust diurnal oscillation of central metabolic processes

Jana Stöckel, Eric A. Welsh, Michelle Liberton, Rangesh Kunvvakkam, Rajeev Aurora, and Himadri B. Pakrasi

5. Identifying Regulatory Changes to Facilitate Nitrogen Fixation in the Nondiazotroph Synechocystis sp. PCC 6803

Thomas J. Mueller†Eric A. Welsh‡Himadri B. Pakrasi§ Costas D. Maranas*†

6. TRANSCRIPTIONAL ANALYSIS OF THE UNICELLULAR, DIAZOTROPHIC CYANOBACTERIUM CYANOTHECE SP. ATCC 51142 GROWN UNDER SHORT DAY/NIGHT CYCLES

Jörg Toepel Jason E. McDermott Tina C. Summerfield Louis A. Sherman

4 Appendix A

CommonName	Function	pathway
41 cce_0042	histidinol-phosphate phosphatase, HAD-superfamily hydrolase subfamily IIIA	nan
144 kaiB4	putative circadian clock protein	nan
296 rpaA	two-component response regulator	nan
301 cmpC	bicarbonate transport system ATP-binding protein	CO2 uptake
317 cce_0319	putative 5-layer OprB family carbohydrate-selective porin	nan
420 kaiC1	circadian clock protein	nan
421 kaiB1	circadian clock protein	nan
422 kaiA	circadian clock protein	nan
433 kaiB3	circadian clock protein	nan
459 ntcA	nitrogen-responsive regulatory protein	nan
546 nifZ	iron-sulfur cofactor synthesis protein	Nitrogen fixation
557 nifH	nitrogenase iron protein	Nitrogen fixation
558 nifD	nitrogenase molybdenum-iron protein alpha chain	Nitrogen fixation
559 nifK	nitrogenase molybdenum-iron protein beta chain	Nitrogen fixation
569 cce_0571	2Fe-2S ferredoxin, putative nitrogen fixation related protein	nan
587 cce_0589	cytochrome c family protein	nan
599 sigE	group 2 sigma-70 RNA polymerase sigma factor E	nan
642 sigB	group 2 sigma-70 RNA polymerase sigma factor B	nan
676 cce_0678	two-component response regulator	nan
718 cce_0720	putative peptidoglycan-binding peptidase, M23B family	nan
839 pntB	pyridine nucleotide transhydrogenase beta subunit	nan
884 ptsS	phosphate ABC transporter, periplasmic phosphate-binding protein	nan
995 gdhA	glutamate dehydrogenase	Amino acid biosynthesis
1017 cce_1019	glycosyl transferase, group 1	nan
1062 hupL	[NiFe]	nan
1152 cce_1155	Peptidase M48, Ste24p	nan
1220 nirA	ferredoxin-nitrite reductase	nan
1306 rubI	rubredoxin	nan
1310 isiB2	flavodoxin	nan
1479 cce_1482	conserved hypothetical protein	nan
1517 cce_1520	two-component response regulator	nan
1626 glgP1	glycogen phosphorylase	Glycogen degradation
1748 sasA	adaptive-response sensory histidine kinase	nan
1895 patB	probable transcriptional regulator	nan
1943 metS	methionyl-tRNA synthetase	nan
2292 ndhF1	NADH dehydrogenase subunit 5	CO2 uptake
2321 ho2	heme oxygenase	nan

	CommonName	Function	pathway
2327	fur1	ferric uptake regulation protein	nan
2347	cce_2350	putative alpha-helical ferredoxin	nan
2637	cce_2642	circadian phase modifier CpmA-like protein	nan
2698	hypE	hydrogenase expression/formation protein	nan
2703	cce_2708	rfrA family pentapeptide repeat	nan
2962	cce_2967	magnesium-protoporphyrin IX monomethyl ester aerobic oxidative cyclase	nan
3102	cce_3107	elongation factor EF-G fragment	nan
3122	cce_3127	transcription regulator, Fur family	nan
3159	rbcS	ribulose bisphosphate carboxylase small subunit	CO2 fixation
3161	rbcL	ribulose-1,5-bisphosphate carboxylase/oxygenase large subunit	CO2 fixation
3197	icd	isocitrate dehydrogenase (NADP+)	TCA cycle
3293	cce_3298	unknown	nan
3325	groEL2	chaperonin 2	nan
3332	cce_3337	putative Glycosyl transferase, group 1	nan
3373	cce_3378	two-component response regulator	nan
3472	psbA4	photosystem II D1 protein	Photosystem II
3512	cce_3517	putative S-layer OprB family carbohydrate-selective porin	nan
3513	cce_3518	putative S-layer OprB family carbohydrate-selective porin	nan
3517	ndhD2	NADH dehydrogenase subunit 4	CO2 uptake
3581	sigJ	group 3 sigma-70 RNA polymerase sigma factor J	nan
3589	sigD	group 2 sigma-70 RNA polymerase sigma factor D	nan
3622	cce_3627	DUF1257-containing protein	nan
3628	psb27	photosystem II 11 kD protein	Photosystem II
3865	cce_3870	sulfatase	nan
3936	cce_3941	alpha amylase	nan
3959	psal1	photosystem I reaction centre subunit XI Psal	Photosystem I
3967	cytC	adenylylsulfate kinase	nan
4136	cce_4141	conserved hypothetical protein	nan
4214	pgk	phosphoglycerate kinase	Glycolysis
4353	chlh1	magnesium chelatase, subunit H	nan
4407	cce_4412	magnesium-protoporphyrin IX monomethyl ester aerobic oxidative cyclase	nan
4427	glnA	glutamine synthetase, glutamate--ammonia ligase	Amino acid biosynthesis
4470	cce_4475	putative arsenical pump-driving ATPase	nan
4594	cce_4599	putative cytochrome oxidase assembly	nan
4661	pheA	prephenate dehydratase	nan
4711	kaic2	circadian clock protein	nan
4746	cce_4751	two-component hybrid sensor and regulator	nan

5 Appendix B

CommonName	Function	pathway
144 kaiB4	putative circadian clock protein	nan
296 rpaA	two-component response regulator	nan
420 kaiC1	circadian clock protein	nan
421 kaiB1	circadian clock protein	nan
422 kaiA	circadian clock protein	nan
433 kaiB3	circadian clock protein	nan
459 ntcA	nitrogen-responsive regulatory protein	nan
546 nifZ	iron-sulfur cofactor synthesis protein	Nitrogen fixation
557 nifH	nitrogenase iron protein	Nitrogen fixation
558 nifD	nitrogenase molybdenum-iron protein alpha chain	Nitrogen fixation
559 nifK	nitrogenase molybdenum-iron protein beta chain	Nitrogen fixation
569 cce_0571	2Fe-2S ferredoxin, putative nitrogen fixation related protein	nan
599 sigE	group 2 sigma-70 RNA polymerase sigma factor E	nan
642 sigB	group 2 sigma-70 RNA polymerase sigma factor B	nan
1062 hupL	[NiFe]	nan
1306 rubI	rubredoxin	nan
1626 glgP1	glycogen phosphorylase	Glycogen degradation
1748 sasA	adaptive-response sensory histidine kinase	nan
1895 patB	probable transcriptional regulator	nan
2347 cce_2350	putative alpha-helical ferredoxin	nan
2637 cce_2642	circadian phase modifier CpnA-like protein	nan
3102 cce_3107	elongation factor EF-G fragment	nan
3293 cce_3298	unknown	nan
3373 cce_3378	two-component response regulator	nan
3513 cce_3518	putative S-layer OprB family carbohydrate-selective porin	nan
3517 ndhD2	NADH dehydrogenase subunit 4	CO2 uptake
3589 sigD	group 2 sigma-70 RNA polymerase sigma factor D	nan
3628 psb27	photosystem II 11 kD protein	Photosystem II
3865 cce_3870	sulfatase	nan
3936 cce_3941	alpha amylase	nan
3959 psaL1	photosystem I reaction centre subunit XI Psal.	Photosystem I
4136 cce_4141	conserved hypothetical protein	nan
4353 chlH1	magnesium chelatase, subunit H	nan
4407 cce_4412	magnesium-protoporphyrin IX monomethyl ester aerobic oxidative cyclase	nan
4661 pheA	prephenate dehydratase	nan
4711 kaiC2	circadian clock protein	nan
4746 cce_4751	two-component hybrid sensor and regulator	nan

6 Appendix C

	CommonName	Function	pathway
41	cce_0042	histidinol-phosphate phosphatase, HAD-superfamily hydrolase subfamily IIIA	nan
144	kaiB4	putative circadian clock protein	nan
296	rpaA	two-component response regulator	nan
301	cmpC	bicarbonate transport system ATP-binding protein	CO2 uptake
317	cce_0319	putative S-layer OprB family carbohydrate-selective porin	nan
421	kaiB1	circadian clock protein	nan
422	kaiA	circadian clock protein	nan
433	kaiB3	circadian clock protein	nan
459	ntcA	nitrogen-responsive regulatory protein	nan
546	nifZ	iron-sulfur cofactor synthesis protein	Nitrogen fixation
569	cce_0571	2Fe-2S ferredoxin, putative nitrogen fixation related protein	nan
587	cce_0589	cytochrome c family protein	nan
599	sigE	group 2 sigma-70 RNA polymerase sigma factor E	nan
642	sigB	group 2 sigma-70 RNA polymerase sigma factor B	nan
676	cce_0678	two-component response regulator	nan
718	cce_0720	putative peptidoglycan-binding peptidase, M23B family	nan
839	pntB	pyridine nucleotide transhydrogenase beta subunit	nan
884	pstS	phosphate ABC transporter, periplasmic phosphate-binding protein	nan
995	gdhA	glutamate dehydrogenase	Amino acid biosynthesis
1017	cce_1019	glycosyl transferase, group 1	nan
1062	hupL	[NiFe]	nan
1152	cce_1155	Peptidase M48, Ste24p	nan
1220	nirA	ferredoxin-nitrite reductase	nan
1479	cce_1482	conserved hypothetical protein	nan
1517	cce_1520	two-component response regulator	nan
1626	glgP1	glycogen phosphorylase	Glycogen degradation
1748	sasA	adaptive-response sensory histidine kinase	nan
1895	patB	probable transcriptional regulator	nan
2321	ho2	heme oxygenase	nan
2327	fur1	ferric uptake regulation protein	nan
2347	cce_2350	putative alpha-helical ferredoxin	nan
2637	cce_2642	circadian phase modifier CpmA-like protein	nan
2698	hypE	hydrogenase expression/formation protein	nan

CommonName		Function	pathway
2703	cce_2708	rfrA family pentapeptide repeat	nan
3102	cce_3107	elongation factor EF-G fragment	nan
3122	cce_3127	transcription regulator, Fur family	nan
3159	rbcS	ribulose bisphosphate carboxylase small subunit	CO2 fixation
3161	rbcL	ribulose-1,5-bisphosphate carboxylase/oxygenase large subunit	CO2 fixation
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3332	cce_3337	putative Glycosyl transferase, group 1	nan
3373	cce_3378	two-component response regulator	nan
3472	psbA4	photosystem II D1 protein	Photosystem II
3513	cce_3518	putative S-layer OprB family carbohydrate-selective porin	nan
3517	ndhD2	NADH dehydrogenase subunit 4	CO2 uptake
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3589	sigD	group 2 sigma-70 RNA polymerase sigma factor D	nan
3622	cce_3627	DUF1257-containing protein	nan
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3865	cce_3870	sulfatase	nan
3936	cce_3941	alpha amylase	nan
3959	psalI	photosystem I reaction centre subunit XI Psal	Photosystem I
3967	cysC	adenylylsulfate kinase	nan
4136	cce_4141	conserved hypothetical protein	nan
4214	pgk	phosphoglycerate kinase	Glycolysis
4353	chiH1	magnesium chelatase, subunit H	nan
4407	cce_4412	magnesium-protoporphyrin IX monomethyl ester aerobic oxidative cyclase	nan
4427	glnA	glutamine synthetase, glutamate-ammonia ligase	Amino acid biosynthesis
4594	cce_4599	putative cytochrome oxidase assembly	nan
4661	pheA	prephenate dehydratase	nan
4711	kaiC2	circadian clock protein	nan
4746	cce_4751	two-component hybrid sensor and regulator	nan

7 Appendix D

CommonName	Function	pathway
296 rpaA	two-component response regulator	nan
317 cce_0319	putative S-layer OprB family carbohydrate-selective porin	nan
433 kaiB3	circadian clock protein	nan
459 ntcA	nitrogen-responsive regulatory protein	nan
569 cce_0571	2Fe-2S ferredoxin, putative nitrogen fixation related protein	nan
587 cce_0589	cytochrome c family protein	nan
995 gdhA	glutamate dehydrogenase	Amino acid biosynthesis
1017 cce_1019	glycosyl transferase, group 1	nan
1152 cce_1155	Peptidase M48, Ste24p	nan
1306 rub1	rubredoxin	nan
1479 cce_1482	conserved hypothetical protein	nan
1626 gigP1	glycogen phosphorylase	Glycogen degradation
1895 patB	probable transcriptional regulator	nan
2321 ho2	heme oxygenase	nan
2327 fur1	ferric uptake regulation protein	nan
2637 cce_2642	circadian phase modifier CpmA-like protein	nan
2703 cce_2708	rfrA family pentapeptide repeat	nan
3102 cce_3107	elongation factor EF-G fragment	nan
3325 groEL2	chaperonin 2	nan
3332 cce_3337	putative Glycosyl transferase, group 1	nan
3373 cce_3378	two-component response regulator	nan
3472 psbA4	photosystem II D1 protein	Photosystem II
3513 cce_3518	putative S-layer OprB family carbohydrate-selective porin	nan
3517 ndhD2	NADH dehydrogenase subunit 4	CO2 uptake
3589 sigD	group 2 sigma-70 RNA polymerase sigma factor D	nan
3628 psb27	photosystem II 11 kD protein	Photosystem II
3865 cce_3870	sulfatase	nan
3936 cce_3941	alpha amylase	nan
3959 psaL1	photosystem I reaction centre subunit XI PsaL	Photosystem I
3967 cysC	adenylylsulfate kinase	nan
4214 pgk	phosphoglycerate kinase	Glycolysis
4353 chlH1	magnesium chelatase, subunit H	nan
4407 cce_4412	magnesium-protoporphyrin IX monomethyl ester aerobic oxidative cyclase	nan
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4661 pheA	prephenate dehydratase	nan
4711 kaiC2	circadian clock protein	nan