

# References

## References

1. Apte, S.K.: Rearrangements of nitrogen fixation (nif) genes in the heterocystous cyanobacteria. *J. Bioscience* 19 (1994).
2. Bair, C.L. and Black, L.W.: A type IV modification dependent restriction nuclease that targets glucosylated hydroxymethyl cytosine modified DNAs. *J Mol Biol* 366 (2007) 768-78.
3. Biswas, T., Aihara, H., Radman-Livaja, M., Filman, D., Landy, A. and Ellenberger, T.: A structural basis for allosteric control of DNA recombination by lambda integrase. *Nature* 435 (2005) 1059-66.
4. Brusca, J.S., Chastain, C.J. and Golden, J.W.: Expression of the *Anabaena* sp. strain PCC 7120 *xisA* gene from a heterologous promoter results in excision of the *nifD* element. *J Bacteriol* 172 (1990) 3925-31.
5. Brusca, J.S., Hale, M.A., Carrasco, C.D. and Golden, J.W.: Excision of an 11-kilobase-pair DNA element from within the *nifD* gene in *anabaena variabilis* heterocysts. *J Bacteriol* 171 (1989) 4138-45.
6. Buchan, D.W., Minneci, F., Nugent, T.C., Bryson, K. and Jones, D.T.: Scalable web services for the PSIPRED Protein Analysis Workbench. *Nucleic Acids Res* 41 (2013) W349-57.
7. Buchanan-Wollaston, V., Cannon, M.C. and Cannon, F.C.: The use of cloned *nif* (nitrogen fixation) DNA to investigate transcriptional regulation of *nif* expression in *Klebsiella pneumoniae*. *Mol Gen Genet* 184 (1981) 102-6.
8. Cannon, W. and Buck, M.: Central domain of the positive control protein NifA and its role in transcriptional activation. *J Mol Biol* 225 (1992) 271-86.
9. Capone, D.G. and Carpenter, E.J.: Nitrogen fixation in the marine environment. *Science* 217 (1982) 1140-2.
10. Carrasco, C.D., Buettner, J.A. and Golden, J.W.: Programmed DNA rearrangement of a cyanobacterial *hupL* gene in heterocysts. *Proc Natl Acad Sci U S A* 92 (1995) 791-5.
11. Carrasco, C.D. and Golden, J.W.: Two heterocyst-specific DNA rearrangements of *nif* operons in *Anabaena cylindrica* and *Nostoc* sp. strain Mac. *Microbiology* 141 ( Pt 10) (1995) 2479-87.

## References

12. Carrasco, C.D., Holliday, S.D., Hansel, A., Lindblad, P. and Golden, J.W.: Heterocyst-specific excision of the *Anabaena* sp. strain PCC 7120 *hupL* element requires *xisC*. *J Bacteriol* 187 (2005) 6031-8.
13. Champoux, J.J.: DNA topoisomerase I-mediated nicking of circular duplex DNA. *Methods Mol Biol* 95 (2001a) 81-7.
14. Champoux, J.J.: DNA topoisomerases: structure, function, and mechanism. *Annu Rev Biochem* 70 (2001b) 369-413.
15. Chastain, C.J., Brusca, J.S., Ramasubramanian, T.S., Wei, T.F. and Golden, J.W.: A sequence-specific DNA-binding factor (VF1) from *Anabaena* sp. strain PCC 7120 vegetative cells binds to three adjacent sites in the *xisA* upstream region. *J Bacteriol* 172 (1990) 5044-51.
16. Colandene, J.D. and Topal, M.D.: The domain organization of NaeI endonuclease: separation of binding and catalysis. *Proc Natl Acad Sci U S A* 95 (1998) 3531-6.
17. Curatti, L., Flores, E. and Salerno, G.: Sucrose is involved in the diazotrophic metabolism of the heterocyst-forming cyanobacterium *Anabaena* sp. *FEBS Lett* 513 (2002) 175-8.
18. Czurda, S., Jechlinger, W., Rosengarten, R. and Chopra-Dewasthaly, R.: Xer1-mediated site-specific DNA inversions and excisions in *Mycoplasma agalactiae*. *J Bacteriol* 192 (2010) 4462-73.
19. DeLano, W.L.: The PyMOL Molecular Graphics System. Schrödinger, LLC, New York, 2010.
20. Ehira, S.: Transcriptional Regulation of Heterocyst Differentiation in *Anabaena* sp. Strain PCC 7120. *Russian Journal of Plant Physiology* 60 (2013) 443-452.
21. Esposito, D. and Scocca, J.J.: The integrase family of tyrosine recombinases: evolution of a conserved active site domain. *Nucleic Acids Res* 25 (1997) 3605-14.
22. Falcon, L.I., Magallon, S. and Castillo, A.: Dating the cyanobacterial ancestor of the chloroplast. *Isme J* 4 (2010) 777-83.
23. Filser, M., Merrick, M. and Cannon, F.: Cloning and characterisation of *nifLA* regulatory mutations from *Klebsiella pneumoniae*. *Mol Gen Genet* 191 (1983) 485-91.

## References

24. Flores, E. and Herrero, A.: Compartmentalized function through cell differentiation in filamentous cyanobacteria. *Nat Rev Microbiol* 8 (2010) 39-50.
25. Gemmen, G.J., Millin, R. and Smith, D.E.: DNA looping by two-site restriction endonucleases: heterogeneous probability distributions for loop size and unbinding force. *Nucleic Acids Res* 34 (2006) 2864-77.
26. Gibb, B., Gupta, K., Ghosh, K., Sharp, R., Chen, J. and Van Duyne, G.D.: Requirements for catalysis in the Cre recombinase active site. *Nucleic Acids Res* 38 (2010) 5817-32.
27. Goldberg, I., Nadler, V. and Hochman, A.: Mechanism of nitrogenase switch-off by oxygen. *J Bacteriol* 169 (1987) 874-9.
28. Golden, J.W., Carrasco, C.D., Mulligan, M.E., Schneider, G.J. and Haselkorn, R.: Deletion of a 55-kilobase-pair DNA element from the chromosome during heterocyst differentiation of *Anabaena* sp. strain PCC 7120. *J Bacteriol* 170 (1988) 5034-41.
29. Golden, J.W. and Wiest, D.R.: Genome rearrangement and nitrogen fixation in *Anabaena* blocked by inactivation of *xisA* gene. *Science* 242 (1988) 1421-3.
30. Golden, J.W. and Yoon, H.S.: Heterocyst development in *Anabaena*. *Curr Opin Microbiol* 6 (2003) 557-63.
31. Grabbe, R., Klopprogge, K. and Schmitz, R.A.: Fnr Is required for NifL-dependent oxygen control of *nif* gene expression in *Klebsiella pneumoniae*. *J Bacteriol* 183 (2001) 1385-93.
32. Grindley, N.D., Whiteson, K.L. and Rice, P.A.: Mechanisms of site-specific recombination. *Annu Rev Biochem* 75 (2006) 567-605.
33. Guo, F., Gopaul, D.N. and van Duyne, G.D.: Structure of Cre recombinase complexed with DNA in a site-specific recombination synapse. *Nature* 389 (1997) 40-6.
34. Hanahan, D.: Studies on transformation of *Escherichia coli* with plasmids. *J Mol Biol* 166 (1983) 557-80.
35. Haselkorn, R.: Developmentally regulated gene rearrangements in prokaryotes. *Annu Rev Genet* 26 (1992) 113-30.

## References

36. Haselkorn, R., Schichman, S., Milstien, J. and Petricciani, J.: Characteristics of bacteriophage phiV-1 isolated from live virus vaccines. *Proc Soc Exp Biol Med* 158 (1978) 383-7.
37. Henson, B.J., Hartman, L., Watson, L.E. and Barnum, S.R.: Evolution and variation of the *nifD* and *hupL* elements in the heterocystous cyanobacteria. *Int J Syst Evol Microbiol* 61 (2011) 2938-49.
38. Henson, B.J., Pennington, L.E., Watson, L.E. and Barnum, S.R.: Excision of the *nifD* element in the heterocystous cyanobacteria. *Arch Microbiol* 189 (2008) 357-66.
39. Herrero, A., Muro-Pastor, A.M. and Flores, E.: Nitrogen control in cyanobacteria. *J Bacteriol* 183 (2001) 411-25.
40. Ibryashkina, E.M., Zakharova, M.V., Baskunov, V.B., Bogdanova, E.S., Nagornykh, M.O., Den'mukhamedov, M.M., Melnik, B.S., Kolinski, A., Gront, D., Feder, M., Solonin, A.S. and Bujnicki, J.M.: Type II restriction endonuclease R.Eco29kI is a member of the GIY-YIG nuclease superfamily. *BMC Struct Biol* 7 (2007) 48.
41. Jo, K. and Topal, M.D.: Changing a leucine to a lysine residue makes NaeI endonuclease hypersensitive to DNA intercalative drugs. *Biochemistry* 35 (1996) 10014-8.
42. Jones, D.T.: Protein secondary structure prediction based on position-specific scoring matrices. *J Mol Biol* 292 (1999) 195-202.
43. Kaneko, T., Nakamura, Y., Wolk, C.P., Kuritz, T., Sasamoto, S., Watanabe, A., Iriguchi, M., Ishikawa, A., Kawashima, K., Kimura, T., Kishida, Y., Kohara, M., Matsumoto, M., Matsuno, A., Muraki, A., Nakazaki, N., Shimpō, S., Sugimoto, M., Takazawa, M., Yamada, M., Yasuda, M. and Tabata, S.: Complete genomic sequence of the filamentous nitrogen-fixing cyanobacterium *Anabaena* sp. strain PCC 7120. *DNA Res* 8 (2001) 205-13; 227-53.
44. Karunakaran, R., Mehta, O., Kunjadia, P., Apte, S. and Nareshkumar, G.: Excision of *Anabaena* PCC 7120 *nifD* element in *Escherichia coli*: Growth kinetics and RecA regulated *xisA* expression and DNA rearrangement. *Bioresour Technol* 99 (2008) 4551-8.
45. Keck, J.L. and Berger, J.M.: Enzymes that push DNA around. *Nat Struct Biol* 6 (1999) 900-2.

## References

46. Koksharova, O.A. and Wolk, C.P.: Novel DNA-binding proteins in the cyanobacterium *Anabaena* sp. strain PCC 7120. *J Bacteriol* 184 (2002) 3931-40.
47. Krylov, D., Barchi, J. and Vinson, C.: Inter-helical interactions in the leucine zipper coiled coil dimer: pH and salt dependence of coupling energy between charged amino acids. *J Mol Biol* 279 (1998) 959-72.
48. Kumar, K., Mella-Herrera, R.A. and Golden, J.W.: Cyanobacterial heterocysts. *Cold Spring Harb Perspect Biol* 2 (2010) a000315.
49. Kuritz, T., Ernst, A., Black, T.A. and Wolk, C.P.: High-resolution mapping of genetic loci of *Anabaena* PCC 7120 required for photosynthesis and nitrogen fixation. *Mol Microbiol* 8 (1993) 101-10.
50. Lammers, P.J., Golden, J.W. and Haselkorn, R.: Identification and sequence of a gene required for a developmentally regulated DNA excision in *Anabaena*. *Cell* 44 (1986) 905-11.
51. Lammers, P.J., McLaughlin, S., Papin, S., Trujillo-Provencio, C. and Ryncarz, A.J., 2nd: Developmental rearrangement of cyanobacterial *nif* genes: nucleotide sequence, open reading frames, and cytochrome P-450 homology of the *Anabaena* sp. strain PCC 7120 *nifD* element. *J Bacteriol* 172 (1990) 6981-90.
52. Liu, H. and Naismith, J.H.: An efficient one-step site-directed deletion, insertion, single and multiple-site plasmid mutagenesis protocol. *BMC Biotechnol* 8 (2008) 91.
53. Lyons, T.W., Reinhard, C.T. and Planavsky, N.J.: The rise of oxygen in Earth's early ocean and atmosphere. *Nature* 506 (2014) 307-15.
54. Lyras, D., Adams, V., Lucet, I. and Rood, J.I.: The large resolvase TnpX is the only transposon-encoded protein required for transposition of the Tn4451/3 family of integrative mobilizable elements. *Mol Microbiol* 51 (2004) 1787-800.
55. Marchler-Bauer, A., Derbyshire, M.K., Gonzales, N.R., Lu, S., Chitsaz, F., Geer, L.Y., Geer, R.C., He, J., Gwadz, M., Hurwitz, D.I., Lanczycki, C.J., Lu, F., Marchler, G.H., Song, J.S., Thanki, N., Wang, Z., Yamashita, R.A., Zhang, D., Zheng, C. and Bryant, S.H.: CDD: NCBI's conserved domain database. *Nucleic Acids Res* 43 (2015) D222-6.
56. Marcozzi, C., Cumino, A.C. and Salerno, G.L.: Role of NtcA, a cyanobacterial global nitrogen regulator, in the regulation of sucrose metabolism gene expression in *Anabaena* sp. PCC 7120. *Arch Microbiol* 191 (2009) 255-63.

## References

57. Meeks, J.C., Joseph, C.M. and Haselkorn, R.: Organization of the nif genes in cyanobacteria in symbiotic association with Azolla and Anthoceros. Arch Microbiol 150 (1988) 61-71.
58. Miyazono, K., Watanabe, M., Kosinski, J., Ishikawa, K., Kamo, M., Sawasaki, T., Nagata, K., Bujnicki, J.M., Endo, Y., Tanokura, M. and Kobayashi, I.: Novel protein fold discovered in the PabI family of restriction enzymes. Nucleic Acids Res 35 (2007) 1908-18.
59. Moffatt, B.A. and Studier, F.W.: T7 lysozyme inhibits transcription by T7 RNA polymerase. Cell 49 (1987) 221-7.
60. Mucke, M., Kruger, D.H. and Reuter, M.: Diversity of type II restriction endonucleases that require two DNA recognition sites. Nucleic Acids Res 31 (2003) 6079-84.
61. Mulligan, M.E., Buikema, W.J. and Haselkorn, R.: Bacterial-type ferredoxin genes in the nitrogen fixation regions of the cyanobacterium Anabaena sp. strain PCC 7120 and Rhizobium meliloti. J Bacteriol 170 (1988) 4406-10.
62. Mulligan, M.E. and Haselkorn, R.: Nitrogen fixation (nif) genes of the cyanobacterium Anabaena species strain PCC 7120. The nifB-fdxN-nifS-nifU operon. J Biol Chem 264 (1989) 19200-7.
63. Narberhaus, F., Lee, H.S., Schmitz, R.A., He, L. and Kustu, S.: The C-terminal domain of NifL is sufficient to inhibit NifA activity. J Bacteriol 177 (1995) 5078-87.
64. Nickelsen, J. and Rengstl, B.: Photosystem II assembly: from cyanobacteria to plants. Annu Rev Plant Biol 64 (2013) 609-35.
65. Nicolaisen, K., Hahn, A. and Schleiff, E.: The cell wall in heterocyst formation by Anabaena sp. PCC 7120. J Basic Microbiol 49 (2009a) 5-24.
66. Nicolaisen, K., Mariscal, V., Bredemeier, R., Pernil, R., Moslavac, S., Lopez-Igual, R., Maldener, I., Herrero, A., Schleiff, E. and Flores, E.: The outer membrane of a heterocyst-forming cyanobacterium is a permeability barrier for uptake of metabolites that are exchanged between cells. Mol Microbiol 74 (2009b) 58-70.
67. Nunes-Duby, S.E., Kwon, H.J., Tirumalai, R.S., Ellenberger, T. and Landy, A.: Similarities and differences among 105 members of the Int family of site-specific recombinases. Nucleic Acids Res 26 (1998) 391-406.

## References

68. Pingoud, A., Fuxreiter, M., Pingoud, V. and Wende, W.: Type II restriction endonucleases: structure and mechanism. *Cell Mol Life Sci* 62 (2005) 685-707.
69. Pingoud, A. and Jeltsch, A.: Structure and function of type II restriction endonucleases. *Nucleic Acids Res* 29 (2001) 3705-27.
70. Ramaswamy, K.S., Carrasco, C.D., Fatma, T. and Golden, J.W.: Cell-type specificity of the *Anabaena* fdxN-element rearrangement requires xisH and xisI. *Mol Microbiol* 23 (1997) 1241-9.
71. Reuter, M., Kupper, D., Meisel, A., Schroeder, C. and Kruger, D.H.: Cooperative binding properties of restriction endonuclease EcoRII with DNA recognition sites. *J Biol Chem* 273 (1998) 8294-300.
72. Roberts, R.J., Belfort, M., Bestor, T., Bhagwat, A.S., Bickle, T.A., Bitinaite, J., Blumenthal, R.M., Degtyarev, S., Dryden, D.T., Dybvig, K., Firman, K., Gromova, E.S., Gumport, R.I., Halford, S.E., Hattman, S., Heitman, J., Hornby, D.P., Janulaitis, A., Jeltsch, A., Josephsen, J., Kiss, A., Klaenhammer, T.R., Kobayashi, I., Kong, H., Kruger, D.H., Lacks, S., Marinus, M.G., Miyahara, M., Morgan, R.D., Murray, N.E., Nagaraja, V., Piekarowicz, A., Pingoud, A., Raleigh, E., Rao, D.N., Reich, N., Repin, V.E., Selker, E.U., Shaw, P.C., Stein, D.C., Stoddard, B.L., Szybalski, W., Trautner, T.A., Van Etten, J.L., Vitor, J.M., Wilson, G.G. and Xu, S.Y.: A nomenclature for restriction enzymes, DNA methyltransferases, homing endonucleases and their genes. *Nucleic Acids Res* 31 (2003) 1805-12.
73. Roy, A., Kucukural, A. and Zhang, Y.: I-TASSER: a unified platform for automated protein structure and function prediction. *Nat Protoc* 5 (2010) 725-38.
74. Sambrook, J. and Russell, D.W.: Agarose gel electrophoresis. *CSH Protoc* 2006 (2006a).
75. Sambrook, J. and Russell, D.W.: The basic polymerase chain reaction. *CSH Protoc* 2006 (2006b).
76. Sambrook, J. and Russell, D.W.: The Hanahan Method for Preparation and Transformation of Competent *E. coli*: High-efficiency Transformation. *CSH Protoc* 2006 (2006c).
77. Sambrook, J. and Russell, D.W.: Preparation of Plasmid DNA by Alkaline Lysis with SDS: Miniprep. *CSH Protoc* 2006 (2006d).

## References

78. Sambrook, J. and Russell, D.W.: Restriction endonuclease digestion of DNA in agarose plugs. CSH Protoc 2006 (2006e).
- 79.
80. Sambrook, J. and Russell, D.W.: SDS-Polyacrylamide Gel Electrophoresis of Proteins. CSH Protoc 2006 (2006f).
81. Sanderson, K.: Hydrogen production comes naturally to ocean microbe. Nature (2010) 673.
82. Sato, T., Harada, K. and Kobayashi, Y.: Analysis of suppressor mutations of spoIVCA mutations: occurrence of DNA rearrangement in the absence of site-specific DNA recombinase SpoIVCA in *Bacillus subtilis*. J Bacteriol 178 (1996) 3380-3.
83. Sato, T., Samori, Y. and Kobayashi, Y.: The *cisA* cistron of *Bacillus subtilis* sporulation gene *spoIVC* encodes a protein homologous to a site-specific recombinase. J Bacteriol 172 (1990) 1092-8.
84. Schmitz, R.A., Klopprogge, K. and Grabbe, R.: Regulation of nitrogen fixation in *Klebsiella pneumoniae* and *Azotobacter vinelandii*: NifL, transducing two environmental signals to the *nif* transcriptional activator NifA. J Mol Microbiol Biotechnol 4 (2002) 235-42.
85. Seefeldt, L.C., Hoffman, B.M. and Dean, D.R.: Mechanism of Mo-dependent nitrogenase. Annu Rev Biochem 78 (2009) 701-22.
86. Seidi, A., Mie, M. and Kobatake, E.: Recombination system based on cre alpha complementation and leucine zipper fusions. Appl Biochem Biotechnol 158 (2009) 334-42.
87. Shah, G.R., Karunakaran, R. and Naresh Kumar, G.: In vivo restriction endonuclease activity of the *Anabaena* PCC 7120 XisA protein in *Escherichia coli*. Res Microbiol 158 (2007) 679-84.
88. Shi, Y., Zhao, W., Zhang, W., Ye, Z. and Zhao, J.: Regulation of intracellular free calcium concentration during heterocyst differentiation by HetR and NtcA in *Anabaena* sp. PCC 7120. Proc Natl Acad Sci U S A 103 (2006) 11334-9.
89. Smith, M.C., Brown, W.R., McEwan, A.R. and Rowley, P.A.: Site-specific recombination by phiC31 integrase and other large serine recombinases. Biochem Soc Trans 38 (2010) 388-94.

## **References**

90. Stewart, L. and Champoux, J.J.: Assaying DNA topoisomerase I relaxation activity. *Methods Mol Biol* 95 (2001) 1-11.
91. Studier, F.W. and Moffatt, B.A.: Use of bacteriophage T7 RNA polymerase to direct selective high-level expression of cloned genes. *J Mol Biol* 189 (1986) 113-30.
92. Szczepek, M., Mackeldanz, P., Moncke-Buchner, E., Alves, J., Kruger, D.H. and Reuter, M.: Molecular analysis of restriction endonuclease EcoRII from *Escherichia coli* reveals precise regulation of its enzymatic activity by autoinhibition. *Mol Microbiol* 72 (2009) 1011-21.
93. Tamulaitis, G., Solonin, A.S. and Siksnys, V.: Alternative arrangements of catalytic residues at the active sites of restriction enzymes. *FEBS Lett* 518 (2002) 17-22.
94. Tanigawa, R., Shirokane, M., Maeda Si, S., Omata, T., Tanaka, K. and Takahashi, H.: Transcriptional activation of NtcA-dependent promoters of *Synechococcus* sp. PCC 7942 by 2-oxoglutarate in vitro. *Proc Natl Acad Sci U S A* 99 (2002) 4251-5.
95. Toepel, J., Welsh, E., Summerfield, T.C., Pakrasi, H.B. and Sherman, L.A.: Differential transcriptional analysis of the cyanobacterium *Cyanothece* sp. strain ATCC 51142 during light-dark and continuous-light growth. *J Bacteriol* 190 (2008) 3904-13.
96. Topal, M.D. and Conrad, M.: Changing endonuclease EcoRII Tyr308 to Phe abolishes cleavage but not recognition: possible homology with the Int-family of recombinases. *Nucleic Acids Res* 21 (1993) 2599-603.
97. Valladares, A., Herrero, A., Pils, D., Schmetterer, G. and Flores, E.: Cytochrome c oxidase genes required for nitrogenase activity and diazotrophic growth in *Anabaena* sp. PCC 7120. *Mol Microbiol* 47 (2003) 1239-49.
98. Van Duyne, G.D. and Rutherford, K.: Large serine recombinase domain structure and attachment site binding. *Crit Rev Biochem Mol Biol* 48 (2013) 476-91.
99. Vasu, K. and Nagaraja, V.: Diverse functions of restriction-modification systems in addition to cellular defense. *Microbiol Mol Biol Rev* 77 (2013) 53-72.

## References

100. Vinson, C.R., Sigler, P.B. and McKnight, S.L.: Scissors-grip model for DNA recognition by a family of leucine zipper proteins. *Science* 246 (1989) 911-6.
101. Vrana, K.E., Walker, S.J., Rucker, P. and Liu, X.: A carboxyl terminal leucine zipper is required for tyrosine hydroxylase tetramer formation. *J Neurochem* 63 (1994) 2014-20.
102. Walsby, A.E.: Cyanobacterial heterocysts: terminal pores proposed as sites of gas exchange. *Trends Microbiol* 15 (2007) 340-9.
103. Wang, H. and Mullany, P.: The large resolvase TndX is required and sufficient for integration and excision of derivatives of the novel conjugative transposon Tn5397. *J Bacteriol* 182 (2000) 6577-83.
104. Wei, T.F., Ramasubramanian, T.S. and Golden, J.W.: *Anabaena* sp. strain PCC 7120 *ntcA* gene required for growth on nitrate and heterocyst development. *J Bacteriol* 176 (1994) 4473-82.
105. Welsh, E.A., Liberton, M., Stockel, J., Loh, T., Elvitigala, T., Wang, C., Wollam, A., Fulton, R.S., Clifton, S.W., Jacobs, J.M., Aurora, R., Ghosh, B.K., Sherman, L.A., Smith, R.D., Wilson, R.K. and Pakrasi, H.B.: The genome of *Cyanothece* 51142, a unicellular diazotrophic cyanobacterium important in the marine nitrogen cycle. *Proc Natl Acad Sci U S A* 105 (2008) 15094-9.
106. Wolk, C.P.: Movement of carbon from vegetative cells to heterocysts in *Anabaena cylindrica*. *J Bacteriol* 96 (1968) 2138-43.
107. Wolk, C.P.: Heterocyst formation. *Annu Rev Genet* 30 (1996) 59-78.
108. Wolk, C.P., Cai, Y., Cardemil, L., Flores, E., Hohn, B., Murry, M., Schmetterer, G., Schrautemeier, B. and Wilson, R.: Isolation and complementation of mutants of *Anabaena* sp. strain PCC 7120 unable to grow aerobically on dinitrogen. *J Bacteriol* 170 (1988) 1239-44.
109. Wyszomirski, K.H., Curth, U., Alves, J., Mackeldanz, P., Moncke-Buchner, E., Schutkowski, M., Kruger, D.H. and Reuter, M.: Type III restriction endonuclease EcoP15I is a heterotrimeric complex containing one Res subunit with several DNA-binding regions and ATPase activity. *Nucleic Acids Res* 40 (2012) 3610-22.
110. Yang, J., Yan, R., Roy, A., Xu, D., Poisson, J. and Zhang, Y.: The I-TASSER Suite: protein structure and function prediction. *Nat Methods* 12 (2015) 7-8.

## **References**

111. Yoon, H.S. and Golden, J.W.: Heterocyst pattern formation controlled by a diffusible peptide. *Science* 282 (1998) 935-8.
112. Zhang, Y.: I-TASSER server for protein 3D structure prediction. *BMC Bioinformatics* 9 (2008) 40.
113. Zhao, M.X., Jiang, Y.L., He, Y.X., Chen, Y.F., Teng, Y.B., Chen, Y., Zhang, C.C. and Zhou, C.Z.: Structural basis for the allosteric control of the global transcription factor NtcA by the nitrogen starvation signal 2-oxoglutarate. *Proc Natl Acad Sci U S A* 107 (2010) 12487-92.
114. Zhou, X.E., Wang, Y., Reuter, M., Mackeldanz, P., Kruger, D.H., Meehan, E.J. and Chen, L.: A single mutation of restriction endonuclease EcoRII led to a new crystal form that diffracts to 2.1 Å resolution. *Acta Crystallogr D Biol Crystallogr* 59 (2003) 910-2.