

## **CURRICULUM VITAE**

**Steven M. Theg**

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Molecular & Cellular Biology (*secondary*)  
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### **EDUCATION**

1977-1981 Molecular Biophysics Program at Florida State University, Tallahassee, FL.  
Ph.D. in Molecular Biophysics awarded in December 1981.

1974-1977 Boston College, Chestnut Hill, MA. Graduated cum laude with B.S. in Biological  
Science, May 1977.

### **PROFESSIONAL EXPERIENCE**

August 2006 – October 2008  
Associate Dean, Undergraduate Academic Programs, College of Biological Sciences

August 2005 – July 2006  
Interim Associate Dean, Undergraduate Academic Programs, College of Biological  
Sciences

July 1998 – present  
Professor, Section of Plant Biology (*primary affiliation*) and Section of Molecular &  
Cellular Biology (*secondary affiliation*), University of California, Davis, CA.

October 2001 – January 2003  
Interim Chair, Section of Plant Biology, University of California, Davis, CA.

### **PROFESSIONAL EXPERIENCE (cont.)**

July 1994-June 1998

Associate Professor, Sections of Plant Biology and Molecular & Cellular Biology,  
University of California, Davis, CA.

Sept. 1988-June 1994

Assistant Professor, Department of Botany, University of California, Davis, CA.

Aug. 1986-Aug. 1988

Postdoctoral research associate with Professors B.R. Selman in the Department of  
Biochemistry, and K. Keegstra in the Department of Botany, University of Wisconsin.

Feb. 1983-Aug. 1986

Postdoctoral research associate with Professor R.A. Dilley in the Department of  
Biological Sciences, Purdue University. Projects involved investigations of the  
involvement of protons in a nonequilibrating pool in the thylakoid membrane with the  
backreactions in photosystem II and with ATP synthesis. Other projects were concerned  
with the location of the lesions in the electron transport chain produced by chloride  
depletion and photoinhibition.

Oct. 1981-Dec. 1982

Postdoctoral research associate with Professor W. Junge in the Department of  
Biophysics, Universitaet Osnabrueck, Osnabrueck, Federal Republic of Germany.  
Project involved investigation of flash-induced proton deposition into chloroplasts by  
photosystem II, and the influence of low concentrations of uncouplers thereon.

Sept. 1977-Oct. 1981

Graduate Research Assistant with Professor P.H. Homann in the Institute of Molecular  
Biophysics, Florida State University. Thesis, entitled "Studies on the composition and  
organization of the oxidizing side of photosystem II in chloroplasts", involved  
investigation of electron transport in and around photosystem II of green plants,  
including the requirements for chloride and manganese, and the arrangement of light  
harvesting pigments around the photosystem II reaction center.

## **EXTRAMURAL SUPPORT**

### **Past**

- NSF: Assembly of a multimeric protein complex. April 1989 - March 1993,  
\$260,000.
- NSF: Acquisition of a kinetic flash spectrophotometer/fluorimeter/luminometer.  
July 1990 - June 1992, \$43,200.
- NSF: Plant Cell Biology Training Program (Theg is one of 13 Co-P.I.s.).  
July 1991 - June 1995, \$1,260,875.  
July 1995 - June 2003, \$938,530

### **EXTRAMURAL SUPPORT (cont.)**

**Past**

- USDA: A component of the chloroplast protein transport complex. September 1992 - August 1995, \$130,000.
- USDA: 95-37304-2325: Components of the Thylakoid Protein Transport Machinery. September 1995 - September 1998, \$100,000.
- USDA: 95-37304-2325: Components of the Thylakoid Protein Transport Machinery. September 1999 - September 2001, \$105,000.
- DOE: DE-FG03-93ER20118: Protein transport and assembly in chloroplasts.  
July 1993 - June 1996, \$276,00.  
July 1996 – June 1999, \$294,000.  
July 1999 – June 2002, \$300,000.  
July 2002 – June 2003, \$100,000.  
DE-FG02-03ER15405: Energetics of protein transport across chloroplast membranes. July 2003 - June 2007, \$330,000.
- NSF: MCB-0080202: Development of an in vitro assay for chloroplast protein targeting in the moss *Physcomitrella patens*. August 2000 – July 2003, \$200,000.
- NSF: MCB 0400365: Chloroplast protein transport in the moss *Physcomitrella patens*. August 2003 – July 2007, \$477,414.
- DOE: DE-FG02-03ER15405: Energetics of protein transport across chloroplast membranes. July 2007 - June 2010, \$330,000.

**Current**

- DOE: DE-FG02-03ER15405: Energetics and mechanisms of protein transport across chloroplast membranes. July 2010 – December 2011, \$240,000.
- NSF: MCB-0956484: Functions of Stromal Chaperones in Chloroplasts of *Physcomitrella Patens*. January 2010 – December 2013, \$850,632.00.

**PROFESSIONAL SOCIETIES AND ACTIVITIES**

American Association for the Advancement of Science  
American Society of Plant Physiologists  
Editorial Board Member, Journal of Biological Chemistry, Jan. 2004 – Dec. 2008

### **Invited talks and meeting activities since 1998**

August 1998	Invited speaker, International Congress on Photosynthesis, Budapest
September 1998	Invited speaker, Gordon Conference, Mitochondria & Chloroplasts, Les Diablerets, Switzerland
November 1998	Invited speaker, Japan Euglena Meeting
January 1999	Invited speaker, Western Photosynthesis Conference, Asilomar, CA
March 1999	Invited seminar, TAMU, TX
June 2000	Invited speaker, ASM meeting: Macromolecular Transport across Cellular Membranes, Savannah
September 2000	Invited seminar, Stockholm University, Stockholm
January 2001	Invited seminar, University of Houston, TX
July 2001	Session chair, ASPB annual meeting, RI
April 2002	Invited speaker, American Society of Biochemistry and Molecular Biology annual meeting
July 2002	Invited speaker, FASEB Conference on Membrane Molecular Biophysics
September 2003	Poster presentation, Moss 2003, MO
September 2003	Invited seminar, University of South Carolina, SC
October 2003	Invited lecture, University of California – Berkeley, CA
March 2004	Invited seminar, Florida State University, FL
July 2004	Invited speaker, Gordon Conference, Mitochondria & Chloroplasts, N.H.
August 2005	Invited speaker, International Congress on Photosynthesis, Montreal
August 2005	Discussion leader, International Congress on Photosynthesis, Montreal
April 2005	Invited speaker, Cellular Protein Translocation. Experiments & Theory, Warwick, GB
June 2005	Invited speaker, Gordon Conference, Protein Transport Across Cellular Membranes, N.H.
July 2005	Speaker, Moss 2005, Brno, Czech Republic
February 2006	Seminar, University of Freiburg
August 2006	Invited speaker, Gordon Conference, Mitochondria & Chloroplasts, Oxford, GB
July 2007	Invited speaker, International Congress on Photosynthesis, Glasgow
April 2008	Invited seminar, TAMU, TX
August 2008	Invited speaker, Gordon Conference, Mitochondria & Chloroplasts, Maine
September 2008	Invited seminar, Florida State University, FL
December 2008	Invited seminar, University of Florida, FL
January 2009	Invited speaker, Western Photosynthesis Conference, Asilomar, CA
January 2010	Session chair, Invited speaker, Western Photosynthesis Conference, Asilomar, CA
April 2010	Session chair, Gordon Conference, Protein Transport Across Cellular Membranes, TX

### **PUBLICATIONS**

## Research Articles

1. Theg, S.M. and Sayre, R.T. (1979) Characterization of chloroplast manganese by electron paramagnetic resonance spectroscopy. *Plant Sci. Lett.* 16, 319-326.
2. Theg, S.M. and Homann, P.H. (1981) Studies on the organization of photosystem II. In: *Proc. 5th Intl. Congress on Photosynthesis* (Akoyunoglou, G., ed.) polypeptide. 309-318. Balaban Intl. Sci. Services, Philadelphia.
3. Theg, S.M. and Homann, P.H. (1982) Light-, pH- and uncoupler-dependent association of chloride with chloroplast thylakoids. *Biochim. Biophys. Acta* 679, 221-234.
4. Theg, S.M., Johnson, J.D. and Homann, P.H. (1982) Proton efflux from thylakoids induced in darkness and its effect on photosystem II. *FEBS Lett.* 145, 25-29.
5. Trissl, H.-W., Förster, V., Theg, S.M. and Junge, W. (1982) Investigations of energy conserving reactions in chromatophores and chloroplast thylakoids. In: *Photochemical, Photoelectrochemical and Photobiological Processes* (Hall, D.O., Palz, W. and Pirrwitz, D., eds.) vol. 2, pp. 179-187. D. Reidel Publishing Co., Boston.
6. Theg, S.M. and Junge, W. (1983) The effect of low concentrations of uncouplers on the detectability of proton deposition in thylakoids: Evidence for subcompartmentation and preexisting pH differences in the dark. *Biochim. Biophys. Acta* 723, 294-307.
7. Junge, W., Theg, S.M., Qian, L.P., Hong, Y.Q. and Viale, A. (1983) Transient trapping of PS II-released protons: (a) by a site within PS II and (b) by CFO after mild extraction of CF1. In: *Proc. 6th Intl. Congress on Photosynthesis* (Sybesma, C., ed.) Vol. II, pp. 4.247-4.255. Martinus Nijhoff/Dr. W. Junk Publishers, The Hague.
8. Westerhoff, H.V., Helgersson, S.L., Theg, S.M., Van Kooten, O., Wikstrom, M., Skulachev, V.P. and Demoshazy, Zs. (1983) The present state of the chemiosmotic coupling theory. *Acta Biochem. Biophys. Sci. Hung.* 18, 125-149.
9. Theg, S.M., Jursinic, P. and Homann, P.H. (1984) Studies on the mechanism of chloride action on photosynthetic water oxidation. *Biochim. Biophys. Acta* 766, 636-646.
10. Theg, S.M., Filar, L.J. and Dilley, R.A. (1986) Photoinactivation of chloroplasts already inhibited on the oxidizing side of photosystem II. *Biochim. Biophys. Acta* 849, 104-111.
11. Cramer, W.A., Theg, S.M. and Widger, W.R. (1986) Recent progress on the structure, and a current hypothesis for the function, of cytochrome b-559. *Photosyn. Res.* 10, 247-258.
12. Theg, S.M., Belanger, K.M. and Dilley, R.A. (1986) Interaction of photosystem I-derived protons with the water-splitting enzyme complex- Evidence for localized domains. *J. Bioenerg. Biomembr.* 19, 53-68.
13. Theg, S.M. and Dilley, R.A. (1986) Protons contained in the thylakoid sequestered

- domains are utilized for energizing ATP formation. In: Prog. in Photosynth. Res. (Biggins, J., ed.) vol. 3, pp. 2.161-2.164. Martinus Nijhoff/Dr. W. Junk Publishers, The Hague.
14. Dilley, R.A., Theg, S.M. and Beard, W.A. (1987) Membrane-proton interactions in chloroplast bioenergetics: Localized proton domains. *Ann. Rev. Plant Physiol.* 38, 347-389.
  15. Theg, S.M., Chiang, G. and Dilley, R.A. (1988) Protons in the thylakoid sequestered domains pass through the coupling factor during ATP synthesis in flashing light. *J. Biol. Chem.* 263, 673-681.
  16. Yu, L.M., Merchant, S., Theg, S.M. and Selman, B.R. (1988) Isolation of a cDNA clone for the gamma subunit of the chloroplast ATP synthase of *Chlamydomonas reinhardtii*: Import and cleavage of the precursor protein. *Proc. Natl. Acad. Sci. USA* 85, 1369-1373.
  17. Lubben, T.H., Theg, S.M. and Keegstra, K.G. (1988) Transport of proteins into chloroplasts. *Photosyn. Res.* 17, 173-194.
  18. Olsen, L.J., Theg, S.M., Selman, B.R. and Keegstra, K. (1989) ATP is required for the binding of precursor proteins to chloroplasts. *J. Biol. Chem.* 264, 6724-6729.
  19. Theg, S.M., Bauerle, C., Olsen, L.J., Selman, B.R. and Keegstra, K. (1989) Internal ATP is the only energy requirement for the translocation of precursor proteins across chloroplastic membranes. *J. Biol. Chem.* 264, 6730-6736.
  20. Keegstra, K., Olsen, L.J. and Theg, S.M. (1989) Recent advances in the import of proteins into chloroplasts. *Ann. Rev. Plant Physiol. & Molec. Biol.* 40, 471-501.
  21. Li, H., Theg, S.M., Bauerle, C.M. and Keegstra, K. (1990) Metal-ion-center assembly of ferredoxin and plastocyanin in isolated chloroplasts. *Proc. Natl. Acad. Sci. USA* 87, 6748-6752.
  22. Yuan, J., Cline, K. and Theg, S.M. (1991) Cryopreservation of chloroplasts and thylakoids for studies of protein import and integration. *Plant Physiol.* 95, 1259-1264.
  23. Renganathan, M., Pan, R.-S., Ewy, R.G., Theg, S.M., Allnutt, F.T.C. and Dilley, R.A. (1991) Evidence that localized energy coupling in thylakoids can continue beyond the energetic threshold onset into steady illumination. *Biochim. Biophys. Acta* 1059, 16-27.
  24. Ettinger, W.E. and Theg, S.M. (1991) Physiologically active chloroplasts contain pools of unassembled extrinsic proteins of the photosynthetic oxygen-evolving enzyme complex in the thylakoid lumen. *J. Cell Biol.* 115, 321-328.

25. Cline, K., Ettinger, W.F. and Theg, S.M. (1992) Protein-specific energy requirements for transport across or into thylakoid membranes: Two luminal proteins are transported in the absence of ATP. *J. Biol. Chem.* 267, 2688-2696.
26. Theg, S.M. and Geske, F.J. (1992) Biophysical characterization of a transit peptide directing chloroplast protein import. *Biochemistry* 31, 5053-5060.
27. Ettinger, W.F. and Theg, S.M. (1992) Sequence of the cDNA encoding the 17 kDa protein of the photosynthetic oxygen-evolving complex of pea. *Plant Physiol.* 99, 791-793.
28. Theg, S.M. and Scott, S.V. (1993) Protein import into chloroplasts. *Trends in Cell Biology* 3, 186-190.
29. Lippuner, V., Chou, I.T., Scott, S.V., Ettinger, W.F., Theg, S.M. and Gasser, C.S. (1994) Cloning and characterization of chloroplast and cytosolic forms of cyclophilin from *Arabidopsis thaliana*. *J. Biol. Chem.* 269, 7863-7868.
30. Leheny, E.A. and Theg, S.M. (1994) The apparent inhibition of chloroplast protein import by cold temperatures is due to energetic considerations, not membrane fluidity. *The Plant Cell* 6, 427-437.
31. Hashimoto, A., Yamamoto, Y. and Theg, S.M. (1995) Studies in the assembly of the oxygen-evolving complex from subunits newly imported into isolated intact chloroplasts. In *Photosynthesis: from Light to Biosphere* (Mathis, P., ed.) vol. III, pp. 857-860, Kulwer Academic Publishers, The Netherlands.
32. Teter, S.A. and Theg, S.M. (1995) Thylakoid protein translocation by the  $\Delta$ pH-dependent pathway is not accompanied by a large increase in membrane conductivity. In *Photosynthesis: from Light to Biosphere* (Mathis, P., ed.) vol. III, pp. 795-798, Kulwer Academic Publishers, The Netherlands.
33. Scott, S.V. and Theg, S.M. (1996) A new intermediate on the pathway for chloroplast protein import reveals distinct translocation machineries in the two envelope membranes: energetics and mechanistic implications. *J. Cell Biol.* 132, 63-75.
34. Hashimoto, A., Yamamoto, Y. and Theg, S.M. (1996) Unassembled subunits of the photosynthetic oxygen-evolving complex present in the thylakoid lumen are long-lived and assembly-competent. *FEBS Lett.* 391, 29-34.
35. Roffey, R.A. and Theg, S.M. (1996) Analysis of the import of carboxyl-terminal truncations of the 23 kDa subunit of the oxygen-evolving complex suggest thylakoid transport of the folded protein. *Plant Physiol.* 111:1329-1338.
36. Hashimoto, A., Ettinger, W.F., Yamamoto, Y. and Theg, S.M. (1997) *In organello* assembly of newly imported oxygen-evolving complex subunits in isolated chloroplasts: sites of assembly and mechanism of binding. *The Plant Cell* 9:441-452.

37. Clark, S.A. and Theg, S.M. (1997) A folded protein can be transported across chloroplast envelope and thylakoid membranes. *Mol Biol Cell* 8:923-93.
38. Theg, S.M. (1998) Protein targeting into and within chloroplasts. In: *Lipid and Protein Traffic: Pathways and Molecular Mechanisms*, J.A.F. Op den Kamp, ed., pp. 17 – 39. Springer-Verlag, Berlin Heidelberg.
39. Leheny, E.A., Teter, S.A. and Theg, S.M. (1998) Identification of a role for an azide-sensitive factor in the thylakoid transport of the 17-kda subunit of the photosynthetic oxygen-evolving complex. *Plant Physiol.* 166:805-814
40. Teter, S.A. and Theg, S.M. (1998) Energy-transducing thylakoid membranes maintain a high ion permeability barrier during protein translocation. *Proc. Natl. Acad. Sci. USA* 95:1590-1594.
41. Tamura, N., Tsuda, T., Tanaka, I. and Theg, S.M. (1998) Reassembly of the photosynthetic water-oxidizing complex on the thylakoid membranes. In: *Photosynthesis: Mechanisms and Effects* (Garab, G, ed.) Vol. II, pp. 1443-1446. Kluwer Academic Publishers, The Netherlands.
42. Havrilla, M.E., Alder, N.N. and Theg, S.M. (1998) Protein transport and assembly in thylakoids. In: *Photosynthesis: Mechanisms and Effects* (Garab, G, ed.) Vol. IV, pp. 3063-3068. Kluwer Academic Publishers, The Netherlands.
43. Musser, S.M. and Theg, S.M. (2000) Characterization of the early steps of OE17 precursor transport by the thylakoid  $\Delta$ pH/Tat machinery. *Eur. J. Biochem.* 267:2588-2598.
44. Musser, S.M. and Theg, S.M. (2000) Proton transfer limits protein translocation rate by the thylakoid Tat machinery. *Biochemistry* 39:8228-8233.
45. Ishikawa, Y., Yamamoto, Y., Otsubo, M., Theg, S.M. and Tamura, N. (2001) Chemical modification of the amino groups on PSII proteins retards photoassembly of the photosynthetic water-oxidizing complex. *Biochemistry* 41:1972-80.
46. Moseley, J.L., Page, M.D., Alder, N.P., Eriksson, M., Quinn, J., Soto, F., Theg, S.M., Hippler, M. and Merchant, S. (2001) Reciprocal expression of two di-iron enzymes affecting photosystem I and light-harvesting complex accumulation. *The Plant Cell* 14: 673-688.
47. Alder, N.N. and Theg, S.M. (2003) Energetics of protein transport across biological membranes: A study of the thylakoid  $\Delta$ pH-dependent/cpTat pathway. *Cell* 112:231-242.
48. Alder, N.N. and Theg, S.M. (2003) Kinetics and cooperativity of protein transport via the thylakoid  $\Delta$ pH-dependent / cpTat pathway. *FEBS Lett* 540:96-100.



49. Alder, N.N. and Theg, S.M. (2003) Energy Utilization by Biological Protein Transport Systems. *Trends in Biochemical Sciences* 28:442-451.
50. Hofmann, N.R. and Theg, S.M. (2003) Chloroplast protein transport in the moss, *Physcomitrella patens*: Conserved machineries between vascular and non-vascular plants. *Plant Molecular Biology* (with cover photo) 53:643-654.
51. Page M.L., Hamel P.P, Gabilly S.T., Zegzouti H., Perea J.V., Alonso J.M., Ecker J.R., Theg S.M., Christensen S.K. and Merchant S. (2004) A homolog of prokaryotic thiol disulfide transporter CcdA is required for the assembly of the cytochrome b6f complex in *Arabidopsis* chloroplasts. *J. Biol. Chem* 279: 32474-32482.
52. Theg, S.M., Cline, K., Finazzi, G. and Wollman, F.-A. (2005) The energetics of the chloroplast Tat protein transport pathway revisited – CORRESPONDENCE. *Trends in Plant Science* 10: 153-154.
53. Hofmann, N. R. and Theg, S.M. (2005) Toc64 is not required for protein import into chloroplasts. *The Plant Journal* 43: 675-87.
54. Hofmann, N.R. and Theg, S.M. Theg (2005) Integration of proteins into the chloroplast outer envelope membrane. *Trends in Plant Science* 10: 450-457.
55. Inoue, K., Potter, D., Shipman, R.L., Perea, J.V. and Theg. S.M. (2005) Involvement of a type I signal peptidase in biogenesis of chloroplasts – Towards identification of the enzyme for maturation of the chloroplast protein translocation channel. In *Photosynthesis: Fundamental Aspects to Global Perspectives*, eds. van der Est A and Bruce D. (Allen Press, Lawrence), pp. 933-935.
56. Inoue K, Baldwin AJ, Shipman RL, Matsui K, Theg SM and Ohme-Takagi M. (2005) Complete maturation of the plastid protein translocation channel requires a type I signal peptidase. *J Cell Biol.* 2005 Nov 7;171(3):425-30.
57. Theg, S.M. and Shi, L.-X. (2005) Protein transport and post-translational processing in Photosystem II biosynthesis and homeostasis. In *Photosystem II: The Light-Driven Water:Plastoquinone Oxidoreductase*, eds. Wydrzynski, T.J. and Satoh, K. (Springer, Berlin), pp. 669-682.
58. Hofmann, N.R. and Theg. S.M. (2005) Protein- and energy-mediated targeting of proteins to the chloroplast outer envelope membrane. *The Plant Journal* 44:917-927.
59. Lu, Y-K., Theg, S.M. and Stemler, A.J. (2005) Carbonic Anhydrase activity of the Photosystem II OEC-33 protein from pea. *Plant Cell Physiol.* 46:1944-53.
60. Chehab, E.W., Perea, J.W., Gopalan, B., Theg, S.M. and Dehesh, K. (2006) Oxylin pathway in rice and *Arabidopsis* . *J. Int. Plant Biol.* 49: 43-51.

61. Armstrong, M.T., Theg, S.M., Braun, N., Wainwright, N., Pardy, R.L. and Armstrong, P.B. (2006) Histochemical evidence for lipid A (endotoxin) in eukaryote chloroplasts. *FASEB J.*20:2145-6.
62. Radhamony, R.N. and Theg, S.M. (2006) Evidence for an ER to Golgi to chloroplast protein transport pathway. *Trends Cell Biol.*16:385-387.
63. Braun, N.A., Davis, A.W. and Theg, S.M. (2007) The chloroplast Tat pathway utilizes the transmembrane electric potential as an energy source. *Biophys J.* 93:1993-1998.
64. Cline, K. and Theg, S.M. (2007) The Sec and Tat protein translocation pathways in chloroplasts. In *The Enzymes*, vol. 25, eds. Dalbey, R.E., Koehler, C.M. and Tamanoi, F. (Elsevier, New York), pp. 463-492.
65. Braun, N.A. and Theg, S.M. (2008) The cpTat pathway transports substrates in the dark. *J. Biol. Chem.* 283:8822-8828.
66. Theg, S.M. (2010) Measurement of the Energetics of Protein Transport across the Chloroplast Thylakoid Membrane. In *Methods in Molecular Biology: Protein Secretion Protocols*, ed. A. Economou, vol. 619: 323-337.
67. Shi, L-X. and Theg, S.M. (2010) A Stromal Hsp70 System Functions in Protein Import into Chloroplasts in the Moss *Physcomitrella patens*. *The Plant Cell* 22: 205-220.
68. Lo, S.M. and Theg, S.M. (2011) Protein Targeting Across and Into Chloroplast Membranes. In *Methods in Molecular Biology: Photosynthesis Research Protocols*, ed. R. Carpentier, vol 684, 139 – 157.
69. Theg, S.M. and Tom, C. (2010) Measurement of the  $\Delta$ pH and electric field developed across Arabidopsis thylakoids in the light. In *Methods in Molecular Biology: Chloroplast Research in Arabidopsis: Methods and Protocols*, ed. P. Jarvis (Humana Press, Totowa, New Jersey), *in press*.
70. Shi, L-X. and Theg, S.M. (2011) The motors of protein import into chloroplasts. *Plant Signaling & Behavior*, *in press*.

## Books

1. Jemiolo, D.K. and Theg, S.M. (1999) Student Solutions Manual, Study Guide and Problems Book to accompany Garrett & Grisham BIOCHEMISTRY, Second Edition, Saunders College Publishing, Philadelphia.
2. Jemiolo, D.K. and Theg, S.M. (2001) Student Study Guide and Problems Book for PRINCIPLES OF BIOCHEMISTRY WITH A HUMAN FOCUS, Garrett & Grisham, Saunders College Publishing, Philadelphia.

3. Jemiolo, D.K. and Theg, S.M. (2004) Student Solutions Manual, Study Guide and Problems Book for Garrett & Grisham's BIOCHEMISTRY, Third Edition, Thompson Brooks/Cole, Belmont.
4. Jemiolo, D.K. and Theg, S.M. (2009) Student Solutions Manual, Study Guide and Problems Book for Garrett & Grisham's BIOCHEMISTRY, Fourth Edition, Thompson Brooks/Cole, Belmont.