

AURIJIT SARKAR

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High Point University,
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PROFESSIONAL EXPERIENCE

- 1. Tenure-track Assistant Professor of Basic Pharmaceutical Science**
March 2016 to current date
Department of Basic Pharmaceutical Sciences, Fred Wilson School of Pharmacy, High Point University, One University Parkway, High Point NC 27265 USA
- 2. Postdoctoral Fellow**
August 2012 to February 2016
Department of Medicinal Chemistry, School of Pharmacy, Virginia Commonwealth University, 800 E. Leigh St. Suite 205, Richmond VA 23219-1540 USA
Advisor: Dr Umesh R Desai, Professor in Medicinal Chemistry
Project: Understanding the physicochemical basis for glycosaminoglycan-protein interaction specificity
- 3. Postdoctoral Research Assistant**
September 2010 to August 2012
Division of Biological Chemistry and Drug Discovery, College of Life Sciences, University of Dundee, Dow Street, Dundee DD1 5EH, UK
Advisor: Dr Ruth Brenk, Lecturer in Biological Chemistry & Drug Discovery
Project: Identification of drug targets and computer-aided drug discovery against *Pseudomonas aeruginosa*
- 4. Teaching Assistant/Research Assistant**
August 2005 to August 2010
Department of Medicinal Chemistry, School of Pharmacy, Virginia Commonwealth University, 800 E. Leigh St. Suite 205, Richmond VA 23219-1540 USA
- 5. Lecturer in Engineering Chemistry**
July 2004 to February 2005
Department of Engineering Chemistry, Central India Institute of Technology, Bypass Road, Indore MP India
- 6. Lecturer in Applied Chemistry**
August 2003 to June 2004
Department of Applied Chemistry, SGS Institute of Technology and Science, 23 Park Road, Indore MP, India

EDUCATION

- 1. Doctor of Philosophy in Pharmaceutical Sciences**
August 2005 to August 2010
Department of Medicinal Chemistry, Virginia Commonwealth University, 800 E. Leigh St. Suite 205, Richmond VA 23298-1540 USA
Dissertation topic: Development and applications of the HINT forcefield in prediction of antibiotic efflux and virtual screening for antivirals.
Advisor: Dr Glen E Kellogg, Professor in Medicinal Chemistry
- 2. Master of Science in Applied Chemistry (Specialization in Fine Chemicals and Drugs)**
August 2000 to June 2003
Department of Applied Chemistry, Shri GS Institute of Technology and Science, 23 Park Road, Indore MP 452001 India
Dissertation topic: Kinetics of oxidation of cysteine using ammonium metavanadate in acidic medium.

Advisor: Dr Madhavi Verma, Professor in Applied Chemistry

3. **Bachelor of Science in Pharmaceutical Chemistry, Chemistry & Zoology.**
June 1997 to May 2000
Devi Ahilya University / G.M.A. Holkar Science College, AB Road, Indore MP 452001 India

PUBLICATIONS

Original Research – Published, Accepted and In Press (in reverse chronological order)

1. **Sarkar, A.***; Yu, W.; MacKerell, A.D.; Desai, U.R.; Mosier, P.D.* Estimating affinity of glycosaminoglycan-protein interactions. Water dominates antithrombin-heparin interaction specificity. *Glycobiology* **2016**, *26*, 1041-1047. ***co-corresponding authors**
2. **Sarkar, A.**; Desai, U.R. A simple method for discovering druggable, specific glycosaminoglycan-protein systems. Elucidation of key principles from heparin/heparan sulfate-binding proteins. *PLOS ONE* **2015**, *10*, e0141127.
3. **Sarkar, A.**; Brenk, R. To hit or not to hit, that is the question – genome-wide, structure-based druggability predictions for *Pseudomonas aeruginosa* proteins. *PLOS ONE*, **2015**, *10*, e0137279.
4. Boothello, R.*; **Sarkar, A.***; Tran, V.*; Nguyen, T.; Sankaranarayanan, N.V.; Quintero, M.; Mehta, A.; Alabbas, A.; Mencio, C.; Joice, A.C.; Kuberan, B.; Desai, U.R. A heparan sulfate containing rare 2-O-sulfonated glucuronic acid residues. *ACS Chem. Biol.* **2015**, *10*, 1485–1494. ***equally contributing authors**
5. Argade, M.D.; Mehta, A.Y.; **Sarkar, A.**; Desai, U.R. Discovery and biophysical characterization of allosteric inhibitors of factor XI_a. *J. Med. Chem.* **2014**, *57*, 3559-3569.
6. Sidhu, P.S.; Abdel Aziz, M.H.; **Sarkar, A.**; Mehta, A.Y.; Zhou, Q.; Desai, U.R. Designing allosteric regulators of thrombin. Exosite 2 features multiple sub-sites that can be targeted by sulfated small molecules for inducing inhibition. *J. Med. Chem.* **2013**, *56*, 5059–5070.
7. Alphey, M.S.; Pirrie, L.; Torrie, L.S.; Boulkeroura, W.A.; Gardiner, M.; **Sarkar, A.**; Maringer, M.; Oehlmann, W.; Brenk, R.; Scherman, M.S.; McNeil, M.; Rejzek, M.; Field, R.A.; Singh, M.; Gray, D.; Westwood, N.J.; Naismith, J.H. Allosteric competitive inhibitors of glucose-1-phosphate thymidyltransferase (RmlA) from *Pseudomonas aeruginosa*. *ACS Chem. Biol.* **2013**, *8*, 387–396.
8. **Sarkar, A.**; Anderson, K.; Kellogg, G.E. Computational analysis of structure-based interactions and ligand properties can predict efflux effects on antibiotics. *Eur. J. Med. Chem.* **2012**, *52*, 98-110.
9. Krasowski, A.; Muthas, D.; **Sarkar, A.**; Schmitt, S.; Brenk, R. DrugPred: A structure-based approach to predict protein druggability developed using an extensive non-redundant data set. *J. Chem. Inf. Model.* **2011**, *51*, 2829–2842.
10. Farzan, S.F.; Palermo, L.M.; Porotto, M.; Yokoyama, C.; Orefice, G.; Fornabaio, M.; **Sarkar, A.**; Kellogg, G.E.; Greengard, O.; Moscona, A. Premature activation of the paramyxovirus fusion protein before target cell attachment with corruption of the viral fusion machinery. *J. Biol. Chem.* **2011**, *286*, 37945-37954.
11. Li, Q.; Al-Ayoubi, A.; Guo, T.; Zheng, H.; **Sarkar, A.**; Nguyen, T.; Eblen, S.; Grant, S.; Kellogg, G.E.; Zhang, S. Structure-activity relationship (SAR) studies of 3-(2-amino-ethyl)-5-(4-ethoxy-benzylidene)-thiazolidine-2,4-dione: Development of potential substrate-specific ERK1/2 inhibitors. *Bioorg. Med. Chem. Lett.* **2009**, *19*, 6042-6046.

Review Articles, Book Chapters, Editorials, Book Reviews, Protocols and Miscellaneous

1. Ahmed, M.H.; Amadasi, A.; Bayden, A.S.; Cashman, D.J.; Cozzini, P.; Da, C.; Chen, D.L.; Fornabaio, M.; Koparde, V.N.; Mozzarelli, A.; Parikh, H.I.; **Sarkar, A.**; Scarsdale, J.N.; Spyraakis, F.; Surface, J.A.; Tripathi, A.; Zaidi, S.A.; Kellogg, G.E. Understanding water and its many roles in biological structure: ways to exploit a resource for drug discovery. In a special issue titled *Computer-Aided Drug Discovery in Methods in Pharmacology and Toxicology* **2016**.
2. Sankaranarayanan, N.V.; **Sarkar, A.**; Desai, U.R.; Mosier, P.D. Designing “high affinity, high specificity” glycosaminoglycan sequences through computerized modeling. In *Glycosaminoglycans: chemistry & biology*; Balagurunathan, K., Nakato, H., Desai, U.R. Eds.; Methods Molecular Biology 1229; Springer: New York, NY, **2014**; pp 289-314.

3. Spyraakis, F.; Cozzini, P.; **Sarkar, A.**; Kellogg, G.E. Applying induced fit in drug discovery: square pegs and round holes? *Curr. Top. Med. Chem.* **2011**, *11*, 131-132.
4. **Sarkar, A.**; Kellogg, G.E. Hydrophobicity – shake flasks, protein folding and drug discovery. *Curr. Top. Med. Chem.* **2010**, *10*, 67-83.
5. **Sarkar, A.**; Kellogg, G.E. Book Review of “Computational drug design. A guide for computational and medicinal chemists”. *J. Med. Chem.* **2009**, *52*, 4977.

In Preparation/Submitted

1. Exner, S.; Bandari, S.; Grad, J.-N.; Rebolledo-Rios, R.; Bachvarova, V.; Steffes, G.; Schürmann, S.; Ortmann, C.; Li, L.; Korpos, E.; Ohlig, S.; Steffens, N.; Dreier, R.; Vortkamp, A.; **Sarkar, A.**; Desai, U.R.; Hoffmann, D.; Grobe, K. Direct heparan sulfate interactions regulate hedgehog morphogen transport. (*Manuscript in peer review*)
2. **Sarkar, A.** Enabling design of screening libraries for antibiotic discovery by modeling ChEMBL data. (*Manuscript in revision; copy available on request*)
3. Heath, S.; **Sarkar, A.** Hyperbilirubinemia: a chemical understanding of current challenges and future prospects. (*Manuscript in preparation; copy available on request*)
4. Martin, H.I.; Agnihotri, V.; Yennamalli, R.M.; **Sarkar, A.** A beginner’s guide to measuring binding affinity during biomolecular interactions. (*Manuscript in preparation; copy available on request*)
5. **Sarkar, A.**; Fornabaio, M.; Parikh, H.I.; Bayden, A.S.; Palermo, L.M.; Porotto, M.; Moscona, A.; Kellogg, G.E. Targeting human parainfluenza virus type III hemagglutinin-neuraminidase by virtual screening methodology employing a hydrophobic forcefield: a case of affinity vs. efficacy? (*Manuscript in preparation; copy available on request*)

PRESENTATIONS

Invited lectures:

1. “**Targeting *Pseudomonas aeruginosa*: the (AERO)path to success?**”
High Point University School of Arts & Sciences, High Point NC U.S.A.
March 2017.
2. “**Targeting *Pseudomonas aeruginosa*: from druggability to drugs?**”
High Point University School of Pharmacy, High Point NC U.S.A.
August 2016.
3. “***Pseudomonas aeruginosa*: clinical aspects and drug discovery.**”
High Point University School of Pharmacy, High Point NC U.S.A.
August 2015.
4. “**Computational GAGomics: the bleeding edge**”
Gordon Research Conference and Seminar on Computer-Aided Drug Design, West Dover NH U.S.A.
July 2015.
5. “***Pseudomonas aeruginosa*: from druggability to drugs?**”
Virginia Commonwealth University School of Pharmacy, Richmond VA U.S.A.
January 2014.
6. “**Glycosaminoglycan-protein binding specificity constitutes more than Arg/Lys-sulfate interactions**”
Gordon Research Seminar on Proteoglycans, Andover NH U.S.A.
July 2014.
7. “**In silico study of heparanome for specific binding**”
Virginia Commonwealth University Chemical Biology Symposium, Richmond VA U.S.A.
April 2013.

Poster presentations:

1. “**Computational structural glycosaminoglycan-omics: current state & future prospects**”
A. Sarkar.

- Gordon Research Conference on Glycobiology, Ventura CA U.S.A.
March 2017.
2. ***“Water dominates glycosaminoglycan-protein interaction specificity”***
A. Sarkar.
Gordon Research Conference on Proteoglycans, Andover NH U.S.A.
July 2016.
 3. ***“Computational GAGomics: the bleeding edge”***
A. Sarkar.
Gordon Research Seminar on Computer-Aided Drug Design, West Dover NH U.S.A.
July 2015.
 4. ***“GAGomics: the good, the bad & the ugly”***
A. Sarkar, U.R. Desai.
Inter-Programs for Excellence in Glycosciences (Inter-PEG) Meeting, Bethesda MD U.S.A.
April 2015.
 5. ***“Glycosaminoglycan-protein binding specificity constitutes more than Arg/Lys-sulfate interactions”***
A. Sarkar, U.R. Desai.
Gordon Research Conference & Seminar on Proteoglycans, Andover NH U.S.A.
July 2014.
 6. ***“Specificity of glycosaminoglycan-protein interactions: the role of desolvation”***
A. Sarkar, U.R. Desai.
Experimental Biology (American Society for Biochemistry & Molecular Biology Annual Meeting), San Diego CA U.S.A.
April 2014.
 7. ***“Desolvation in protein-glycosaminoglycan interactions”***
A. Sarkar, U.R. Desai.
Inter-Programs for Excellence in Glycosciences (Inter-PEG) Meeting, Bethesda MD U.S.A.
March 2014.
 8. ***“Computational investigations into protein-glycosaminoglycan interactions”***
A. Sarkar, N.V. Sankarnarayanan, U.R. Desai.
Inter-Programs for Excellence in Glycosciences (Inter-PEG) Meeting, Cleveland OH U.S.A.
April 2013.
 9. ***“Structure-based druggability predictions for Pseudomonas aeruginosa targets”***
A. Sarkar, R. Brenk.
American Chemical Society Spring National Meeting, San Diego CA U.S.A.
March 2012.
 10. ***“High-throughput screening, virtual screening and rational drug design identify potent inhibitors for Pseudomonas aeruginosa RmlA”***
A. Sarkar, M. Gardiner, M.S. Alphey, D. Gray, J. Naismith, R. Brenk.
American Chemical Society Spring National Meeting, San Diego CA U.S.A.
March 2012.
 11. ***“To hit or not to hit – that is the question! Structure-based druggability predictions for Pseudomonas aeruginosa targets”***
A. Sarkar, A. Krasowski, R. Brenk.
International Conference on Chemical Structures, NH Conference Center Leeuwenhorst, Noordwijkerhout, The Netherlands.
June 2011.

12. ***"Efflux prediction by the 'systems hydropathy' approach: an innovative use of docking, scoring and statistical methods"***
A. Sarkar, K. Anderson, G.E. Kellogg.
Keystone Symposium on Computer-Aided Drug Design, Fairmont Chateau Whistler, Whistler BC, Canada.
April 2010.
13. ***"In search of entropy, site flexibility, water and other cool stuff"***
G.E. Kellogg, A. Tripathi, **A. Sarkar**, J.A. Surface, A.S. Bayden, A. Amadasi, A. Mozzarelli, F. Spyraakis, P. Cozzini.
Gordon Conference on Computer-Aided Drug Design, Tilton School, Tilton NH U.S.A.
July 2009.
14. ***"Optimizing models for protein-ligand interactions using a hydrophobic force field: application to design of novel probes for ERK2"***
A. Sarkar, S. Zhang, G.E. Kellogg.
American Chemical Society Fall National Meeting, Philadelphia PA
August 2008.
15. ***"Computational screening, docking and scoring of potential new inhibitors of human parainfluenza virus type III."***
A. Sarkar, M. Fornabaio, A. Bayden, M. Porotto, L. Palermo, A. Moscona and G.E. Kellogg.
24th Annual Daniel T. Watts Symposium, Virginia Commonwealth University, Richmond VA U.S.A.
October, 2007.
16. ***"Virtual screening for inhibitors of human parainfluenza virus type III."***
A. Sarkar, M. Fornabaio, A. Bayden, M. Porotto, L. Palermo, A. Moscona and G.E. Kellogg.
VCU School of Pharmacy Research & Career Day, Richmond VA U.S.A.
October, 2007.

AWARDS/HONORS

1. ***Best postdoctoral poster award, 2016***
Awarded at *ISB3D Symposium 2016*, Virginia Commonwealth University, Richmond VA
2. ***Travel award, 2015***
Awarded by the Gordon Research Conference on Computer-Aided Drug Design, Mt Snow VT
3. ***International Society for Matrix Biology Young Scientist Award, 2014***
Awarded by the International Society for Matrix Biology at the Gordon Research Conference on Proteoglycans, Andover NH
4. ***Mary Louise Andrews Award, 2014***
A grant awarded by the Mary Louise Andrews Trust through Virginia Academy of Science
5. ***Travel award, 2015***
Awarded by the Experimental Biology (American Society for Biochemistry & Molecular Biology Annual Meeting), San Diego CA
6. ***Charles T. Rector and Thomas W. Rorrer, Jr. Dean's Award, 2010***
Awarded by the School of Pharmacy, Virginia Commonwealth University
7. ***J. Doyle Smith Award, 2010***
Awarded by the Department of Medicinal Chemistry, Virginia Commonwealth University
8. ***Travel Award, 2010***
Awarded by the Keystone Symposium on Computer-Aided Drug Design, Whistler BC, Canada

SERVICE

Service to the profession

1. **Reviewer**, *Journal of Analytical and Pharmaceutical Chemistry*, since 2016.
2. **Discussion leader**, *Gordon Research Conference on Proteoglycans*, Mt Snow, VT, July 2016.
3. **Reviewer**, *Journal of Medical Virology*, since 2015.
4. **Co-organizer**, Future GlycoGen Session, *Inter-Programs of Excellence in Glycoscience Annual Meeting*, Bethesda MD, March 2014.
5. **Reviewer**, *Bioorganic and Medicinal Chemistry*, since 2013.
6. **Reviewer**, *European Journal of Pharmaceutical Sciences*, since 2013.
7. **Reviewer**, *Letters in Drug Discovery*, since 2013.
8. **Reviewer**, *Computational & Structural Biotechnology Journal*, since 2012.
9. **Co-Editor** with Dr. G.E. Kellogg, Dr. Pietro Cozzini and Dr. Francesca Spyrakis, *special issue, Current Topics in Medicinal Chemistry*, titled "Applying Induced Fit Theory in Drug Design: Square Pegs in Round Holes?" 2011.
10. **President**, *Alpha Student Chapter of the American Chemical Society's Medicinal Chemistry Division* at Virginia Commonwealth University – January 2009 till December 2009.

Service to the university, school or department

1. **Member, university diversity committee** (Fall 2017 – present)
2. **Member, university research committee** (Fall 2017 – present)
3. **Member, school academic standards committee** (Fall 2016 – Fall 2017, Fall 2018 – present)
4. **Member, school curriculum committee** (Fall 2017 – Fall 2018)
5. **Member, school admissions committee** (Spring 2017 – Fall 2017)
6. **Member, department faculty recruitment committee** (Fall 2016)
7. **Co-organizer**, *Inter-School Symposium*, High Point University, High Point, July 2016.
8. **Ad hoc attendee, school curriculum committee** (Spring 2016)
9. **Ad hoc attendee, school assessment committee** (Spring 2016)

PROFESSIONAL AFFILIATIONS

1. **American Chemical Society** – Since 2011
2. **International Society for Matrix Biology** – Since 2014
3. **American Heart Association** – Since 2015
4. **American Association of Colleges of Pharmacy** – Since 2017

GRANTS AWARDED/COMPLETED

1. **Mary Louise Andrews Award, 2014**, by the Mary Louise Andrews Trust through Virginia Academy of Science (\$1500)
Brief project summary: Molecular modeling of ABCG2 efflux pumps
Primary role: Co-Principal Investigator
Purpose: to support an undergraduate student stipend under the guidance of Drs. Aurijit Sarkar and Glen Kellogg at Department of Medicinal Chemistry and Institute for Structural Biology & Drug Discovery, Virginia Commonwealth University

CURRENT FUNDING

1. **New Investigator Award, 2019**, by the American Association of Colleges of Pharmacy (\$10,000)
Brief project summary: Towards targeting antibiotic resistance *Staphylococcus aureus*
Primary role: Principal Investigator
Purpose: to support a project aimed at (1) understanding compounds that translocate the outer envelope of antibiotic-resistant *Staphylococcus aureus* to reach their targets, and (2) identify initial hits against a serine-threonine kinase involved in antibiotic resistance.

2. **High Point University Explorer Grant, 2017** (\$7,500)
Brief project summary: To identify the target of a small molecule capable of resensitizing MRSA towards beta-lactam antibiotics and to define the structure-function relationship for optimization of activity.
Primary role: Co-Principal Investigator with Meghan Blackledge
3. **High Point University startup funds, 2016** (\$100,000)

UNFUNDED GRANT APPLICATIONS

1. **Mizutani foundation for advancement of glycoscience, 2017** (\$56,000)

RESEARCH STUDENTS/TRAINEES SUPERVISED

1. **Kristen Korankyi**, PharmD Student Researcher, High Point University, Fall 2016 –
2. **Savannah Heath**, PharmD Student Researcher, High Point University, Spring 2018 –
3. **Sara Hall**, PharmD Student Researcher, High Point University, Spring 2018 –
4. **Allie King**, PharmD Student Researcher, High Point University, Spring 2019 –
5. **Mindy Prince**, PharmD Student Researcher, High Point University, Spring 2019 –
6. **Dominico Marra**, PharmD Student Researcher, High Point University, Spring 2019 –
7. **Alex Sauer**, PharmD Student Researcher, High Point University, Spring 2019 –
8. **Taylor Sistare**, Undergraduate Researcher, High Point University, Spring 2019 –
9. **Ashton Huff**, Undergraduate Researcher, High Point University, Spring 2019 –

RESEARCH STUDENTS/TRAINEES SUPERVISED

1. **Trey Patton**, Undergraduate Researcher, High Point University, Fall 2016 – Spring 2017: left as a graduate student at University of Montana.
2. **Gianna Beckmann**, Undergraduate Researcher, High Point University, Fall 2017 – Spring 2018: currently applying for Physician's Assistant programs nationally.
3. **Lauren Harris**, Undergraduate Researcher, High Point University, Fall 2017 – Spring 2018: currently accepted into the PharmD program at Fred Wilson School of Pharmacy at High Point University.
4. **Alena DePaola**, Undergraduate Researcher, High Point University, Fall 2017 – Spring 2018: currently continuing her education as a biology major at High Point University
5. **Chris Moran**, PharmD Student Researcher, High Point University, Fall 2017 – Spring 2018: currently finishing year 3 of the PharmD program before moving onto clinical rotations.
6. **Josiah Howard**, PharmD Student Researcher, High Point University, Fall 2017 – Spring 2018: currently finishing year 3 of the PharmD program before moving onto clinical rotations.

COURSES TAUGHT

1. **Integrated Pharmaceutical Sciences II**, Spring 2018 – present. **Duties:** As lecturer: Essential pathophysiology, medicinal chemistry, and pharmacology for drugs used in: pyelonephritis, cystitis, infectious arthritis, osteomyelitis, bacterial meningitis, brain abscess, infective endocarditis, acute otitis media, acute bacterial rhinosinusitis, acute pharyngitis, acute bronchitis, chronic bronchitis, bronchiolitis, and pneumonia (only bacterial infections).
2. **Research Design & Analysis**, Fall 2017 – present. **Duties:** As coordinator: Designing the syllabus, overall coordination of entire course, including inviting lecturers, setting assessments on ExamSoft, and managing grade books on Blackboard. As lecturer: clinical research design methods, essential statistics for statistical data analysis, literature search methodologies, and literature review criteria.
3. **Integrated Pharmaceutical Sciences I**, Fall 2017 – present. **Duties:** As lecturer: (Fall 2017) Essential physiology, medicinal chemistry, and pharmacology for the following topics: electrolyte balance in sodium

- and potassium imbalances; physiology and methods of hemodialysis and peritoneal dialysis; (*Fall 2018 - present*) erectile dysfunction.
4. **Medicinal Chemistry & Pharmacology**, Spring 2017 – present. **Duties:** As lecturer: Drugs for diabetes (insulin, glucosidase inhibitors, biguanides, sulfonyl ureas, PPAR- γ agonists, DPP4 inhibitors, incretin mimetics and SGLT-2 inhibitors) and respiratory drugs (M3 muscarinic receptor antagonists, Beta 2 adrenergic receptor agonists, glucocorticoid receptor antagonists, antitussives, expectorants, leukotriene antagonists, 5-lipoxygenase inhibitors)
 5. **Introduction to Immunology**, Spring 2017 – present. **Duties:** As coordinator: Designing the syllabus and overall coordination tasks, including inviting lecturers, setting assessments on ExamSoft, and managing grade books (Blackboard). As lecturer: Introduction to immunology (overview, medical relevance & cells/organs), Innate immunity & inflammation, antibody structure/function, and hypersensitivity type II.
 6. **Pharmaceutics**, Spring 2017 – present. **Duties:** As lecturer: Chemical kinetics and importance in pharmaceutical dosage forms.
 7. **Introduction to Medicinal Chemistry**, Fall 2016 – present. **Duties:** As lecturer: chemical bonds and functional groups, stereochemistry, and acids & bases
 8. **Introduction to Pharmacology**, Fall 2016 – present. **Duties:** As lecturer: Lectures on biochemical interactions, energetics, chemical equilibrium, enzymes & enzyme kinetics, carbohydrates & their metabolism (glycolysis, TCA cycle, glycogenolysis and gluconeogenesis – Fall 2016 only)